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Telephone Engineer

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How to Stop Losses from TERMITES

Every purchaser and user of poles should know about the habits of both subterranean and non-subterranean termites and how best to combat them so as to prevent serious and unexpected service interruptions and losses.

In a recent issue of Electrical West, there appeared an article on termites by Dr. Thomas E. Snyder, Entomologist of the Bureau of Entomology, U. S. Department of Agriculture. Under the heading "Termite Pole Damage in California," Dr. Snyder presents the results of much study on this subject, and certain conclusions and recommendations which should interest every user of poles.

Get A FREE Copy!

With a view of the benefits which will come to the power transmission and telephone industries (of which we consider our organization an integral part) through better knowledge of the "Termite problem---and its solution," we have had a number of reprints of Dr. Snyder's article made. One or more copies of this interesting and informative treatise will be sent without cost to any one requesting it.

Termite Pole Damage in California

By Thomas E. Snyder

A WOODEN pole used for telephone, telegraph, electric light or power service is merely an uprooted dead tree with roots and bark removed. Hence it is subject to attack by wood-boring insects and decay or rot just as is a dead tree. Poles in general formerly were not treated with chemical wood preservatives, as now in almost universality, as necessary for proper protection from wood-boring insects and wood-destroying decay. The termite or white ant is one of the most destructive types of the most which damage and destroy poles.

HAVING recently completed an extensive personal survey of the termite ravages in the California area, Dr. Snyder, widely know entomologist, here gives a resume of some of his observations. He presents interesting information regarding termites themselves and comments upon various methods of protecting against termite inroads.

Termites or "white ants" are not true ants although they are superficially ant-like and live in large colonies made up of different forms or castes, and are social insects. In these nests or colonies both winged and wingless mature individuals are produced. The brownish or blackish, elongated, slender, ant-like, winged or blackish with long white wings, unlike second adults. Fig. 1 (1) with long white wings, unlike the other forms have functional eyes and are able to

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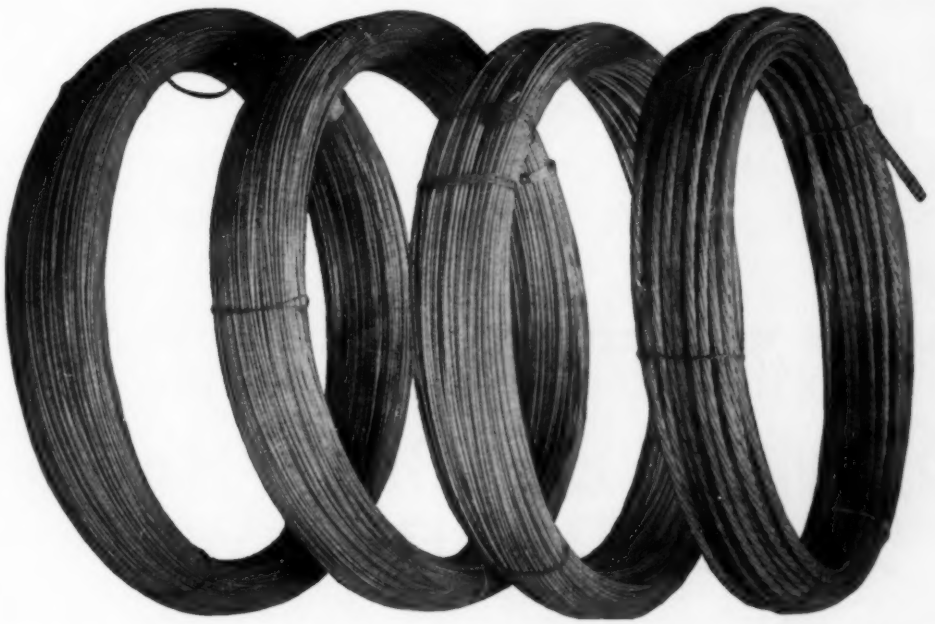

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the last 50 to 100 ft.—the drop wire—is as important as the miles of line back of it. Any failure of the drop wire destroys the usefulness of the entire line as far as the subscriber is concerned.

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Telephone Engineer

Volume 32 SEPTEMBER, 1928 No. 9

"Good Material and Poor Work"—or?

At the meeting of Indiana telephone people at Lake Wawassee, Sam Tomlinson of the Winona Telephone Company closed his illuminating talk on rehabilitation of run-down exchanges with the following words: "Of the two things, good material and poor work or poor material and good work, I would choose the latter. Poor work will spoil the best of material and good work will be able to do a lot toward restoring good service in a badly run down plant."

It seems to us that a volume might be written on this subject and yet the story is told completely in the simple words and concise statements quoted. Having known Friend Sam for a long period of years we know that he is not advocating the purchase of poor material but is referring to getting the most out of poor material that will be found in every run-down plant.

It is surprising how much improvement in service can be made by the application of good work to the most unpromising materials of a run-down plant.. Trimming trees, resetting or stubbing poles, remaking connections with sleeves or soldering them and pulling slack require practically no material but do wonders in reducing troubles and interruptions of service and in improving transmission.

Ultimately, of course, a run-down plant will have to be rebuilt, but as a first aid measure there is nothing better than the judicious application of good workmanship by a competent man.

Plant Accounting Is Not Difficult

We have been wondering how many telephone companies have put into effect the system of plant accounting recommended by the Accounting Division of the United States Independent Telephone Association. Some of the companies which have placed it in use have found that it is not such a tremendous job to get the plant quantities and the unit prices necessary to handle plant retirements in a systematic way. Neither is it such a problem to get satisfactory work reports and to maintain perpetual inventories of materials and supplies even in properties of moderate size.

One manager who is his own accountant tells us that the time and effort has been well repaid in the satisfaction of knowing that his accounts are kept properly, to say nothing of the advantage which he found during a check-up by the public service commission of his state in connection with a recent issue of securities.

Vacation Is Over; Survey the Job

Vacation time is now over and telephone people are settling back to the job of keeping things moving in their usual channels. Due to disarrangement of schedules incident to the annual vacations many things have been left until the operating forces return to normal and many changes are not made until every one is back on the job. One of the supposed benefits of a vacation is that the worker returns to the job refreshed after a change from the routine of the year's work. It may be fairly assumed that this is the case, and if so, there is no better time to make a survey of the job to see if the coming year is going to be one of progress and development or whether things are going to slip along in the same old way as they have last year and all the years before. How many milestones of progress will we have passed by the time another vacation time rolls around?

Telephones and Automobiles

It seems to be the fashion to make comparisons between the telephone industry and the automobile industry. Both industries have contributed greatly to the reduction of time and labor in carrying on the business and social life of the country and in that respect are to some extent comparable. In other ways, however, there is little similarity. The telephone subscriber is dependent upon all other telephone users for his service both as to the amount and quality of his service. The automobile user, on the other hand, is affected very

little, or not at all, by the kind and character of the car his neighbor drives.

The nature of the telephone business has, in itself, tended to popularize the use of the telephone until it has become one of the most widespread services in the country. In the case of the automobile, the development of the business to its present size has not been aided by the need of additional users in order to increase the service of existing owners. If, as we are told, there are more automobiles than telephones in use in this country, it is because the automobile industry has done better selling of its product than the telephone industry. We have developed this thought in previous comments in these columns.

We have also developed to some extent the idea that the telephone industry can learn from the automobile industry in the merchandising of its product. One of the points in this line of thought that we do not believe has been emphasized to the extent that it will bear, is the fact that the automobile industry has been able to market a product that is suited to the pocketbook of almost every prospective buyer. In this respect, the telephone industry has lagged to some degree.

While the telephone industry can not extend its price range for service to the point where the highest price class is, say, eight times the price of the lowest class, it can follow to a greater extent than it has done. We have seen any number of rate schedules where the highest class of service is only one-sixth to one-third higher than the lowest price class. Furthermore, when rate adjustments have been made we have seen the same ratios maintained in the new rates.

Applying this to the automobile world, if the lowest price car is six hundred dollars, the highest price car would be nine hundred dollars or at the other end of the scale, if the highest price car is four thousand dollars the lowest price car would be three thousand dollars. In the first case the price would be too low to permit the development of the finer grades of automobiles, while in the second case sales would be restricted because the number of people who can afford a three thousand dollar car is very limited.

There is evidence in some recent rate schedules that this is beginning to be understood in the telephone business and we are beginning to see a greater spread between the highest and lowest price classes of telephone service. We also have seen the introduction of intermediate classes between the highest and lowest. A proper arrangement of these schedules will provide a higher class of service and produce more revenue from those who are willing and able to pay and will keep the lower price classes within reach of the great majority so that the development will not be restricted.

Publicity the Practical Way

The petition of a group of subscribers in a certain city for a reduction of rates after the installation of an automatic exchange on the ground that service should be cheaper as the subscribers do the work of switching, seems to a telephone man to be the height of ignorance of the operation of a telephone system. Whether or not those who circulated the petition really believed that their claim was true may be open to doubt, but it seems reasonable to suppose that many of the signers really believed what was set down on the petition.

It scarcely is possible that the telephone company was at fault in not making the situation known for there was ample advance publicity and the subject of telephone service was a matter of common conversation in that city for weeks before the change. Probably few people in the community did not know that the change involved the expenditure of hundreds of thousands of dollars. It is likely that the situation arose out of misunderstanding of the factors which go into the make-up of the cost of giving telephone service, or the production of any other commodity for that matter.

The ordinary man on the street can understand the effect of labor costs and the cost of material upon the price of service and he realizes in a hazy fashion that interest, depreciation and taxes enter. What he does not understand is the fact that investment in a telephone plant is several times the annual revenue that can be derived from its operation. For this reason, he does not give proper weight to those factors when he thinks of the cost of service.

The only suggestion we have to overcome this form of ignorance is to keep everlastingly driving home in our publicity work the fact that taxes, interest and depreciation eat up a large slice of the dollar of telephone revenue. Perhaps constant repetition will get the idea over to at least a portion of the public even if some are never reached by it.

New Feature Added

TELEPHONE ENGINEER is pleased to announce that it has added to its editorial staff the coming year a new feature for this magazine, and one which we believe will prove very popular. Beginning with the October issue, Mr. R. F. DeVoe, of R. F. DeVoe & Company, investment bankers of New York City, will contribute a page each month to "sound financing." Mr. DeVoe is one of the most conservative investment bankers dealing in telephone securities, and his articles, we believe, will be very valuable to the telephone industry.

Studying Telephone Methods

By E. R. COLLINS

Manitoba Telephone System, Brandon, Man

CHAPTER XX

Common Battery Transmitter Feed

In the previous chapter we stated that we would discuss the supply of ringing current for the small Exchange. However, it would seem best at this time to continue our study of the battery supply for Transmitters. We have been studying some of the features of Battery Supply for the Magneto Telephone and the Central Office Transmitters. Our discussion has led us into the problem of supplying more than one transmitter from one battery source. This gives us the phrase *Common Battery* since this battery is common to more than one transmitter. From this we go on to study the supply of battery to the transmitter of the subscribers' telephone from one common source. Those systems using this method are called *common battery systems,* or *central energy systems.*

If we supply the battery from the Exchange to the subscribers' telephone there are two things that will happen. First there will be the flow of battery to the telephone which will be direct current and as such will be flowing steadily in one direction. This we term the direct current flow. Then there will be the voice currents which are alternating in character and of varying frequency over the range of voice frequencies. Thus we have two distinct and different electrical currents flowing in the one wire. This can be easily illustrated by performing the experiment in Fig. 179.

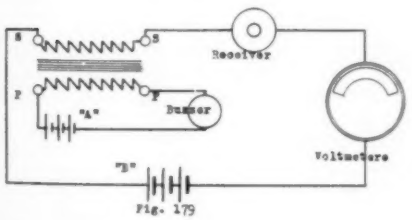


Fig. 179

In Fig. 179 we have an induction coil with a battery "A" and buzzer connected to the primary. A Battery "B" is connected in the secondary circuit with a receiver and a voltmeter in series. The amount of cells used for battery "B" should be just enough to bring the needle of the meter about half way across the scale. Two dry cells should be enough for battery "A," just enough to operate the buzzer without burning the contacts.

Now if battery "B" is connected first in the secondary circuit there will be a reading of the meter. This reading will drop slightly after the circuit is closed for a few minutes. Next connect a telegraph key in the primary circuit in place of the buzzer, and make and break the circuit slowly, watching the voltmeter. It will be observed that there will be movements of the needle for each make and for each break. The induced current in the secondary circuit will be flowing in the same direction as the battery current for one-half cycle, and the needle will read higher. Then during the other half cycle of the induced current, the battery and the induced currents will be in opposite directions and the meter will read lower. This aiding and opposing of the battery current causes the needle to fluctuate. Now if the buzzer is connected in the primary circuit, and adjusted to vibrate at a high pitch, the needle of the voltmeter will remain stationery. The aiding and opposing action is going on just the same, only at such a high rate of time that the needle of the voltmeter due to its weight and length, cannot keep in step with the alternations, and therefore remains constant. But the telephone receiver connected in the secondary circuit will respond to the rapidly alternating current, and the buzz of the receiver will prove that there is an alternating current present in the secondary circuit. Thus we have two distinct currents flowing over one wire, a direct current from the battery which is indicated by the voltmeter, and an alternating current which is indicated by the telephone receiver.

Polarizing of Receivers

In Fig. 179 the receiver is connected in series with the battery "B." The battery will therefore be flowing through the receiver in one direction. If the battery "B" be reversed so that the current will flow in the opposite direction, the current from the battery will naturally flow the opposite way in the receiver. If the strength of the alternating current buzz is noticed for the two directions of the battery, it will be found to be much louder for the one direction than the other. In one case the receiver is polarized, and in the other it is depolarized. The meaning of these two expressions can be explained by studying Fig. 180 for a few minutes.

Fig. 180 shows the mechanism of a telephone receiver. It consists of a permanent magnet, to which is attached two soft iron pole pieces, around which are wound a number of turns of fine insulated wire.

The permanent magnet will have a north pole and a south pole and we will give to each a value of 5 points of strength. The two poles together will therefore exert a pull on the diaphragm

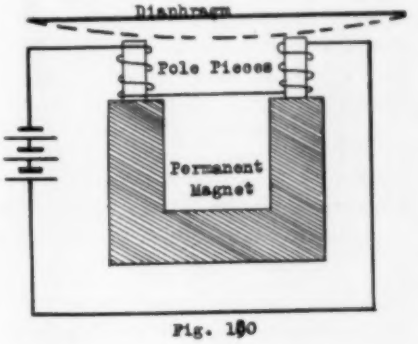


Fig. 180

of 10 units of strength. This will cause the diaphragm (which is held solid around the outer rim) to be pulled in toward the pole pieces of the magnet, due to the pull of the permanent magnet. This is shown by the dotted line. While held in this position, the natural tendency of the diaphragm is to pull away from the pole pieces to get back to its natural position as shown by the solid line. The diaphragm will be under tension similar to a spring that is pulled out long by your two hands. Remove the muscular pull of your arms, and the spring will fly back to its natural position quickly.

Now lay a piece of cardboard over the shaded portion of the drawing 180, and consider the effect of battery flowing in the coils. Suppose enough battery could be passed through the coils to give a magnetic pull of 5 units each pole, then we would have a pull equal to the permanent magnet. Now if the polarity set up by the battery is the same as the polarity of the permanent magnet, then we would have a pull of 20 units on the diaphragm. But suppose the battery were reversed, then the permanent magnet would oppose the magnetic pull of the battery and the result would be 10 units minus 10 units, which would leave no pull on the diaphragm. The result would be that the diaphragm has lost its spring tension. The effect of the diaphragm under tension can be described as follows. When an alternating current is flowing in the receiver coils, with the permanent magnet pulling in the diaphragm, there will be two alternations for each cycle. One alternation will aid the pull of the permanent magnet, and it will move in further toward the pole piece. The other alternation will oppose the permanent and the tension of the diaphragm will take advantage of the weakening of the magnetic

pull, and will fly further away from the permanent magnet. That is the alternating current and the permanent are forces pulling in, and the alternating current and the diaphragm are forces pulling out. The result is a receiver that is very sensitive to weak alternating currents. This effect is quite noticeable on a radio receiving set, where the "B" battery flows through the head phones.

If the flow of direct current were allowed to flow through the coils of a receiver in the opposing magnetic direction, for any length of time, it would have a tendency to weaken the strength of the permanent magnet, and the receiver would become very weak. It is necessary in common battery telephones therefore, to prevent the direct current flowing through the coils of a permanent magnet receiver, because it is not always possible to have the battery flowing in the same direction.

Repeating Coil Battery Supply

One of the most common methods of supplying battery to the subscribers' telephone is the repeating coil method. While this method is quite common in use, there are a few points about it that might be difficult to understand. To illustrate the action of the coil in keeping battery noises away from the talking circuit we might set up the following experiment as shown in Fig. 181.

Here we have a standard repeating coil. This term is used in preference to the word transformer. Transformers may be of any ratio. They may be step up or step down. But for the purpose of connecting telephones, it is necessary to have an equal transfer of energy in both directions. In other words the currents set up in one circuit must be repeated in the other circuit connected by the repeating coil.

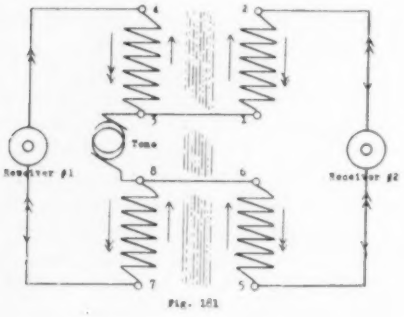


Fig. 181

In Fig. 181 we have a tone connected to the two coils at their center points, 1-3 and 6-8. Two telephone receivers are connected to the outer ends of the coils. The four coils are all wound on one core. The core is usually in the form of a circle, so that the magnetic field has low resistance. One would expect that the tone current would divide, and flow through winding 3-4, receiver No. 1, and back through winding 7-8, and also through winding 1-2, receiver No. 2, and back through winding 5-6. Such is the case, yet there will be almost no sound heard in either receiver. So we have another action which is taking place to prevent the tone being heard. When current flows up through winding 3-4, receiver and winding 7-8, there is immediately induced in the secondary of the repeating coil a current in the opposite direction in winding 5-6 and 2-1, as shown by the double arrows. But there is already a current flowing in these windings as shown by the single arrows. We have already learned that the flow of current in the primary of a transformer depends on the amount of load on the secondary. In this case the load will be the receivers. Since the load on both halves of the transformer are the same the amount of current sent from the tone supply will be equal in both halves of the coil. Therefore the induced current in winding 1-2, 5-6 should equal the impressed current flowing from the tone in the same winding, but in the opposite direction. Therefore these two opposing currents of equal strength should neutralize each other.

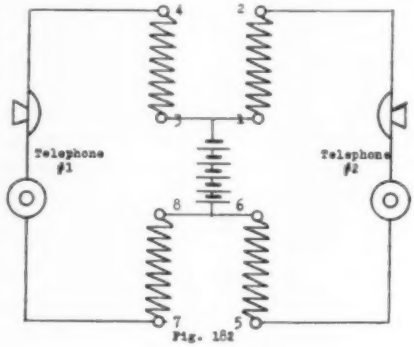


Fig. 182

The same applies to the other half of the coil, because the windings are all equal. If winding 1-2, or any other winding for that matter were short circuited then the balance is upset, and the tone will be quite loud in both the receivers.

In Fig. 182 we have the same repeating coil. The core is not shown for simplicity. Battery is connected to the inner terminals instead of the tone supply, and two telephones are connected in place of the receivers used in Fig. 181. The receiver shown in this circuit can be of the series type. The energy to pull in the diaphragm is supplied by the battery current from the repeating coil. With a series receiver it makes no difference which direction the battery flows through the coils. But such a receiver is of no use unless there is battery flowing to give tension to the diaphragm.

If you were to connect a telephone receiver across the terminals of a storage battery connected to a telephone exchange you would hear quite a medley of noises, caused by relays and other apparatus operating from the battery. These noises are really slight fluctuations of the battery voltage due to the varying load of the exchange. However, these noises will not be so intense as the tone we used in Fig. 181, and they will not find their way into the telephone circuit. Then the next point comes up: how do the voice currents from transmitter No. 1 actuate the receiver No. 2. The transmitter No. 1 will cause variations in the current flow and these changes will cause magnetic variations in the repeating coil or transformer. If the circuit to telephone No. 2 were not connected, the receiver at telephone No. 1 would sound dead and tinny when speaking into No. 1 transmitter. But connect telephone No. 2 as shown in Fig. 182 and the transmitter No. 1 will sound quite loud in the receiver No. 1. The telephone No. 2 places a load on the secondary of the transformer and lowers the impedance of the primary, hence the fluctuating voice currents from No. 1 transmitter will find a low impedance path through the primary. Of course the reverse action takes place when transmitter No. 2 is talking. Here we have a flow of direct battery current from the repeating coil flowing over both lines. When transmitter No. 1 is transmitting, the flow in No. 1 line will be due to fluctuating direct current. This will vary the pull on the diaphragm of the direct current receiver No. 1, reproducing the sound of No. 1 transmitter. In the circuit of telephone No. 2, however, the transmitter is not changing. Therefore, there will be a steady flow of current from the battery in this circuit. But the repeating coil will be inducing alternating currents due to the voltage changes caused by No. 1 transmitter. The receiver No. 2 will be subjected to a steady pull of the battery, but the induced current will cause the tension of the diaphragm to vary. This follows out the experiment of Fig. 179.

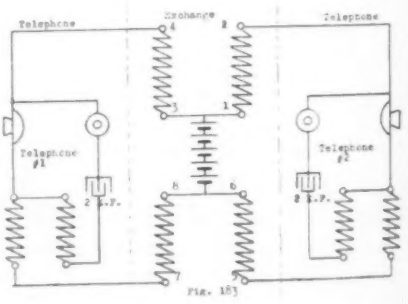


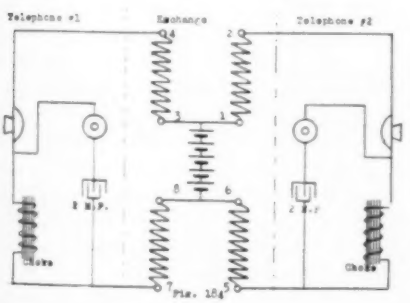
Fig. 183

Induction Coil Telephone

In Fig. 183 we have the same arrangement at the telephone exchange to supply the battery over the lines. There is, however, a difference in the telephone arrangement. The receiver used here will be the polarized or permanent magnet type. A condenser is connected in series with the receiver to prevent the battery from flowing through its coils. There-

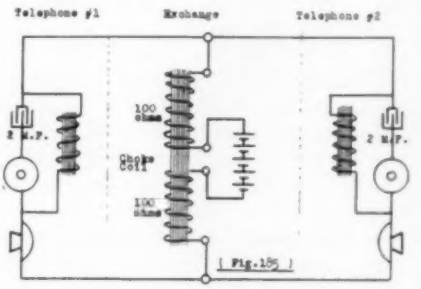
fore, it makes no difference which way this receiver is connected. Suppose telephone No. 1 is transmitting. Then the voltage fluctuations of the transmitter will cause voltage changes in the repeating coil. The battery current also flows through the primary of the induction coil of telephone No. 1. This will induce alternating currents in the secondary winding of the induction coil, which will flow through the receiver and condenser. But the condenser and receiver and secondary of the coil, being in series, are also connected in parallel with the transmitter. Now as the transmitter resistance changes, the voltage of the battery across it will also change. But if the condenser circuit is across the transmitter, each change in voltage across the transmitter will cause a change in the charge across the condenser. Thus the condenser will be charged with each voltage change and will consequently discharge with each voltage change. This discharge current will flow through the secondary windings and induce current in the primary winding of the induction coil. If the windings of the induction coil are connected in the right way this charge and discharge current will assist the changes in the line caused by the transmitter. If the windings are not connected correctly, they will have a weakening effect on transmission.

The combined fluctuations of transmitter and condenser flowing over line No. 1 will repeat into line No. 2. Alternating current will flow through the transmitter of telephone No. 2, and its primary of the induction coil. This flow will induce currents in the secondary which will flow through the condenser and receiver of this telephone. The reverse action takes place when telephone No. 2 is transmitting. The actual gain of the telephone in Fig. 183 over that in Fig. 182 cannot be easily detected on short lines, but on long distance conversations, the induction coil type is quite superior to the series type telephone shown in Fig. 182.



Another method of preventing the receiver from being depolarized is shown in Fig. 184. Here we have the same method of battery feed as shown in Figs. 182 and 183. Instead of an induction coil there is a choke coil used in each telephone. Considering the telephone No. 1 as the transmitter and telephone No. 2 as the receiver. Battery current will flow through the transmitter and choke coil but will not flow through the condenser to the receiver. So we have protected the receiver from being depolarized. Now when the transmitter No. 1 causes the battery current to fluctuate rapidly the choke coil will oppose any fluctuation, by setting up an opposing current for each change caused by the transmitter. These opposing currents will find an easy path through the condenser and the receiver. The fluctuations flowing over the line will act in the repeating coil windings as in the previous circuits. If the condenser and receiver were not connected, but only the choke coil in series with the transmitter, the fluctuating current would be dampened so badly that very little sound would be heard at telephone No. 2.

The action at the receiving end is quite simple. The alternating current induced in the repeating coil will find a low resistance path through the receiver and condenser. But the choke coil will present a high impedance path to the voice currents being shunted through the receiver, where we want it, and yet there is no battery flowing in the receiver circuit.



Impedance Battery Supply

Another type of battery feed is shown in Fig. 185. This type will be found in P. B. X. circuits. It consists of two equally wound coils on a choke coil. The coils are wound on the core and then the whole winding is enclosed in an iron shell. This increases the impedance and also prevents coils which are close together from inducing into each other. Coils of 100 ohms to the side are usually used for 24 volts and 200 ohms to the side where 48 volts are supplied. The direct current of the choke allows the correct average amount of current to flow to each transmitter. Suppose telephone No. 1 is transmitting and telephone No. 2 receiving. No. 1 transmitter will cause voltage fluctuations from the choke coil at the exchange. A low resistance at transmitter No. 1 will draw more current from the choke coil and rob telephone No. 2 of some of its battery. This will cause sound variations. Then the counter induces currents set up by the choke coil and condenser at telephone No. 1 will reinforce these changes, thus increasing the sound heard in telephone No. 2. The action here is quite simple. If two telephones connected to such a circuit were of any great length and one circuit was unbalanced the whole circuit being as one circuit would be badly unbalanced and would be quite noisy. The repeating coil method overcomes such variations in lines connected.

In Fig. 186 we have another type of battery feed. Here there are two choke coils provided and connected with condensers. The transmission efficiency of this circuit is much better than the arrangement of circuit in Fig. 185. The two 2 M. F. condensers connected between the two sets of coils provide a low resistance path to the voice frequencies, but block the flow of battery between the two circuits. The use of this circuit will be further explained. Considering telephone No. 1 as transmitting, voltage fluctuations will be caused across the terminals of No. 1 choke coil. This will also change the voltage charge across the condensers connected to the two terminals of choke coil No. 1. These charge and discharge effects will traverse telephone No. 2. They will not flow down through

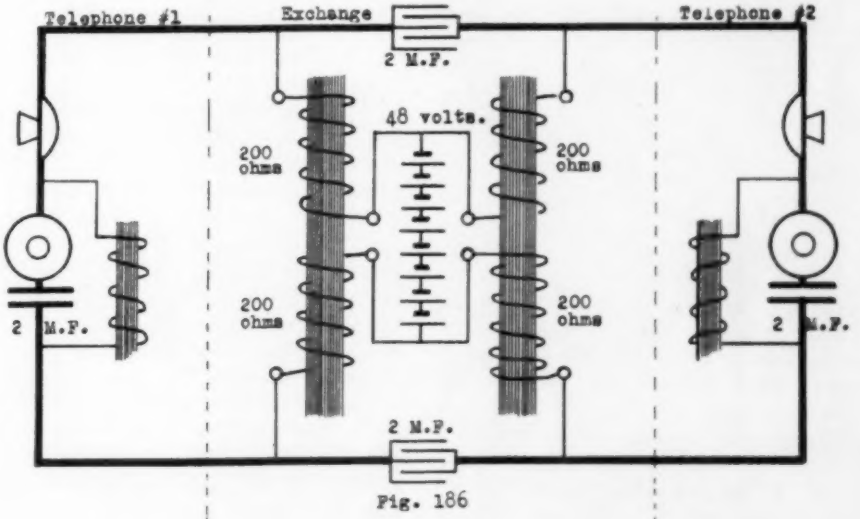


Fig. 186

the choke coil No. 2 on account of its high impedance. Then the counter current effect from telephone No. 1 will seek a path to flow and will not flow into the windings of either choke coil at the exchange, but will flow on through the condensers to telephone No. 2.

The action of the telephones will be the same as in Fig. 185. The balancing effect of this circuit is a little better than Fig. 185, but any unbalance in one circuit will have quite a bad effect on the other.

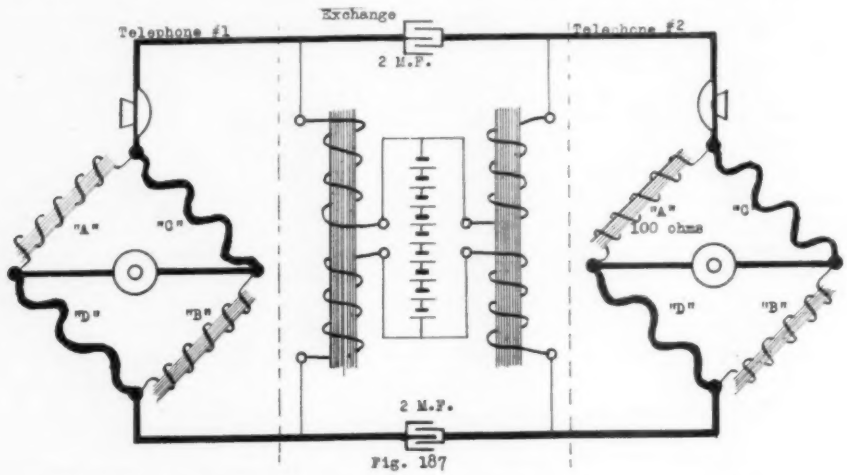


Fig. 187

In Fig. 187 we have another method which while not in general use illustrated nicely how direct and alternating currents can be taken over a single circuit, and then be separated as desired. At each telephone are four coils of equal resistance. For illustration let us say that each coil is 100 ohms in resistance to direct current. Then battery current flowing through the transmitter at telephone No. 1 would flow to the junction of coils "A" and "C." Here the current would divide. If each coil is of the same resistance then there would be the same amount of current flowing in each coil. Let us suppose there are 20 millamperes flowing in each coil "A" and "C." Then the current continues on through coils "D" and "B." If these coils are also of equal resistance there will be 20 millamperes flowing in each of these coils. The result will be that there will be no difference in voltage across the receiver connected midway in this divided circuit. Therefore there will be no battery flow in the receiver. Fluctuations of the battery current caused by the transmitter, will cause a fluctuation of the battery current. But coils "A" and "B" are choke coils of high impedance and will oppose the battery changes with counter currents. Coils "C" and "D," however, are non-inductive and will not oppose these fluctuations, therefore they will flow over the heavy black line which takes them through the receiver and out over the line, and through the condensers, to telephone No. 2. Here due to the choking effect of coil "A" the alternating currents will all go through coil "C"; here coil "B" opposes the alternating voice currents, and they are deflected through the non-inductive winding of coil "D." In this case the receiver gets the full effect of the alternating currents. This is as it should be. And yet there has been no battery flowing through the receiver windings to depolarize them. The receiver used here is of the polarized or permanent magnet type.

In Figs. 186 and 187 the heavy lines denote the flow of the voice currents. At the same time it must be remembered that the battery flow is taking place over the line wires with the alternating voice currents, as illustrated in the experiment of Fig. 179. The foregoing are only a few illustrations of some of the principles involved in such circuits. It is not our intention to try to discuss all types of apparatus used, but rather by studying typical arrangements, to familiarize ourselves with the purpose of the apparatus used in different circuits. A good general knowledge of the operation and application of such apparatus will prepare the student to study and know new apparatus as he may encounter it in his daily work.

A. T. & T. Contracts Broad in Effect

(Wall Street Journal)

One of the most important contracts in wire circles in a quarter of a century has been concluded between American Telephone & Telegraph Co. and the Western Union whereby ultimately the present duplication of parallel pole lines and wire circuits will be largely eliminated. The Western Union under the contract will be able to lease the surplus facilities of the American Telephone & Telegraph Co. This means that as the Western Union plant wears out it can utilize the American Telephone plant and where that plant is not needed, the lease can be given up. The contracts are non-exclusive and the Postal Telegraph Co. undoubtedly will make similar contracts with the telephone company.

These contracts do not affect competition to the slightest degree, but are economical and to a high degree efficient in making for cheaper and better communications throughout the country. They are the result of several years of working out of the plans.

Gifford on Advantages of Arrangement

The following statement has been made by Walter S. Gifford, president of American Telephone & Telegraph Co.:

"The American Telephone & Telegraph Co. has completed arrangements with the Western Union Telegraph Co. that should further the development of electrical communications.

"In order to provide the best possible telephone service at the least cost, American Telephone & Telegraph Co. carries on continuous research and development and maintains a nation-wide network of telephone toll and long distance lines. Some of the developments of its Bell Telephone Laboratories have been incorporated in ocean telegraph cables, resulting in a large increase in capacity of words transmitted. Other developments and inventories of the laboratories can be utilized on telegraph lines and enable additional circuits required by telegraph companies to be superimposed on telephone toll and long distance lines. With the view of placing these developments at the service of the public, American Telephone & Telegraph Co. decided to make them available to telegraph companies and offered a series of non-exclusive contracts to the Western Union Telegraph Co., which have now been executed.

Can Telegraph Over Telephone Lines

"Among them is one for the use of plant which should ultimately result in eliminating to a large extent the present duplication of parallel pole lines and wire circuits since, by the use of proper apparatus, it is possible to telephone and telegraph simultaneously over telephone toll and long distance wires. By this new arrangement many of the advantages that would accrue from the consolidation of all electrical communications will be obtained, and at the same time the complete independence of the telephone and telegraph companies will be maintained.

"A contract has also been entered into by which the Western Union Telegraph Co. may lease the apparatus developed in the Bell Telephone laboratories so that under certain conditions several telegraph channels may be obtained from a single pair of telegraph wires.

"A further contract provides that the Telephone company's telephoto system will be available to the Western Union Telegraph Co.'s patrons for handling facsimile message service between the cities where the Telephone company operates its system of sending pictures by wire."

Practical Suggestions for Plant Valuation

By CHARLES W. McKAY, M. E.*

In the last installment we covered the major portion of the subject of "Collateral Construction Costs," or "Overhead" costs as they are sometimes termed.

In the present installment it is proposed to conclude the discussion of the Collateral Construction Costs—and also to discuss such items as Working Capital; the handling of Construction in Progress (during the appraisal period); Contract Values; Cost of Establishing the Business and Cost of Financing.

Before proceeding with the discussion of the Collateral Construction Costs, I wish to again emphasize the importance of this group of items—especially in view of the fact that many courts and commissions do not clearly understand them and hence are apt to pass them over with "a lick and a promise."

The collateral costs are just as much a part of the total reproduction cost (or even actual cost) as are the costs obtained by pricing out the inventory. Unfortunately, however, their very nature precludes their inclusion in the unit costs. They must be applied to (and computed upon the basis of) the total cost of the inventoriable property—as obtained by applying the unit costs to the inventory as actually resultant from a field count.

This reminds me that the all important subject of unit costs has not been touched upon in this series of articles. In all probability, we will begin the consideration of this important phase of the subject in the October issue—endeavoring to go into such details that you yourself can evolve suitable reproduction unit costs to apply to your inventory.

Returning to the subject in hand—the Collateral Construction Costs:

It may be assumed that interest during construction has been calculated on the average investment for each six months during the construction period at the rate of 6 per cent per annum, compounded semi-annually. Interest has been charged as a construction expense only during the non-operative period of each portion of the property. As soon as the various portions of the property were placed in operation, interest ceased as an item of construction cost.

A schedule of the amounts spent on each of the various items of construction during each of the ten semi-annual periods of the five-year construction period may also be set up. This schedule is also continued through the six semi-annual periods of the sixth, seventh and eight years, so as to show those plant expenditures which are necessarily deferred until all of the business is actually secured. The plant costs during this latter three-year period have not, however, been included in the calculations of interest during construction, because the items involved are conceived to have been put into service as soon as constructed.

A similar table may be prepared showing the value of the plant put into operation during the various periods.

The calculation of interest during construction, based on the first five years of the construction schedule, will be incorporated in a third table.

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SCHEDULE OF CONVENTIONS

Annual convention United States Independent Telephone Association, Sherman Hotel, Chicago, October 16, 17, 18 and 19, 1928.

Annual convention Independent Pioneer Telephone Association, Hotel Sherman, Chicago, October 18, 1928.

NOTICE OF REMOVAL

Business and editorial offices of TELEPHONE ENGINEER have been removed from 236 N. Clark St. to Ogden Building, 192 N. Clark St. We are now located just a few doors north of the Hotel Sherman, and shall be glad to see you any time.

It often happens that a portion of a plant is in progress of construction at the date of appraisal. In cases of this kind, the task of ascertaining the exact status of such work at the appraisal date devolves upon the appraisal engineer. As a rule, plant in process of construction should not be included in the appraisal of the inventoriable property, but should be separately appraised and included with the collateral construction costs under the caption, "Construction in Progress."

When the date of appraisal is practically coincident with the date of inventory, the task is not a difficult one. By reviewing the daily completion reports for estimates and job orders under way at the date of appraisal, and subsequently checking the status of the work by a personal field inspection, it is a comparatively simple matter to determine the reproduction cost of plant in process of construction at the appraisal date.

This reproduction cost may be ascertained either by determining the cost of plant in process of construction as it will be when completed, and subsequently reducing this cost to correspond to the status of the work at the appraisal date, or by estimating in detail the exact expenditures actually made to date. In either case the result should be the same.

Where a large amount of plant is under construction at the appraisal date, it may be well to use both methods in determining the proper allowance for construction in progress.

An illustration of the method of computing working capital, taken from an appraisal of a telephone property, is presented in the following table:

	Average No. of Stations	Average Working Capital	Average per Station
First year—			
1st 6 months..	47,894	$151,011.04	$3.15
2nd 6 months..	52,401	202,756.11	3.87
Second year—			
1st 6 months..	.....	.....	....
2nd 6 months..	61,462	222,136.39	3.71
Third year—			
1st 6 months..	65,115	194,088.47	2.98
Av. 2½ years.	56,818	187,342.49	3.30
Number of stations in service as of appraisal date.....			67,125
67,125 stations at $3.30.....			$221,513
Total working capital.....			221,513

Fig 4—Computation of working capital.

Working capital, in this appraisal, has been taken as those funds necessary to provide for a reasonable cash balance to permit the proper conduct of the business; to provide employes' working funds, and to cover amounts due from subscribers and agents.

It is based on the experience of the company for the two and one-half years prior to the date of the appraisal, and has been calculated on the basis of the average per subscriber's station during this period, applied to the number of subscribers' stations in service at the date of the appraisal.

It occasionally happens that the time at which the reproduction cost of the property is sought antedates the inventory date by several years. In a case of this kind construction in progress must.

of course, be determined entirely by the historical method—by reviewing plant and accounting records and ascertaining as accurately as possible what work was under way at the time of appraisal, and the exact status of the various estimates and work orders as of the appraisal date.

Under certain conditions it may be desirable to gauge the cost of construction in progress by the portion of the total cost that has been actually added to the company's capital account as of the appraisal date. As an illustration, a plant which will eventually cost $100,000 may be in process of construction, and the actual cash expenditure at the date of appraisal may amount to only $50,000.

The prevalent mode of recording completed work may cause considerable delay in transferring costs to the capital account, so that only $10,000 may have found its way into the books at the appraisal rate. In this case $10,000 would represent the appraised cost of construction in progress.

Working Capital.—An operating utility corporation—or for that matter, any other business concern—requires a certain amount of ready cash, or working capital, to transact its everyday business. The company must be in a position to take advantage of discounts offered for prompt payment of bills, and to advance to district managers and commercial agents, periodically, sufficient cash to facilitate the proper handling of the business of their respective departments.

Courts and commissions are in general agreement as to the propriety of including an allowance for working capital in an appraisal for rate-base purposes. The amount required will, of course, depend on the size of the utility and the nature of its business.

The determination of a proper allowance for working capital may either be made on a percentage basis—a percentage of the direct construction costs—or, perhaps somewhat more accurately, by ascertaining the capital required to operate the company for the several years preceding the appraisal, and using this as a gauge of the amount of the working capital which may properly be included in the appraisal.

Relation of Collateral Costs to Other Costs.—In summing up the collateral construction costs it may be again said that each of the component items, with the exception of construction in progress and working capital, represents elements of cost which are just as real and just as essential to the construction of a utility property as those embodied in the unit costs.

It is unfortunate that the collateral costs cannot be included in the unit costs. Their segregation sometimes creates the erroneous impression that they are something entirely apart from the direct construction cost—something that has been added for good measure.

Several cases might be cited where counsel representing municipalities or civic organizations in rate cases, either through ignorance of the subject in hand or through a wilful attempt at misrepresentation have tried to prove that the collateral costs—or "Overheads," as they are sometimes called—are not a real element of cost, but an imaginary value added for the sole purpose of padding the total value of the plant." Fortunately, most of the state commissions, and many of the courts, have had a wide and varied experience in appraisement problems, and are disposed to be absolutely fair in their allowances for collateral construction costs.

Percentage Values of Elements of Collateral Costs.—If computed on the basis of a percentage of the direct construction costs, the usual range of values assigned to the various elements of collateral costs is as follows:

	Per Cent
General and legal expense during construction	2 to 6
Engineering and general supervision during construction	5 to 9
Taxes and insurance during construction	3 to 5
Interest during construction	5 to 8
Total collateral, or overhead, expense	15 to 28

It is customary to determine the present value of the collateral construction costs by depreciating them in the same rate as the direct construction costs. In other words, the ratio of the present value of the direct construction costs to their reproduction costs, when applied to the various elements of collateral cost, will give their respective present values. Working capital and plant in process of construction should not be depreciated, for obvious reasons.

The Non-Physical Assets

Elements of Non-Physical Assets.—In arriving at the total reproduction cost there still remains, after all of the component elements of the cost of the physical property have been considered, the "non-physical assets," sometimes referred to collectively as the "intangible," or "going," value.

Courts and commissions are quite generally agreed as to the propriety of including, in a rate-base appraisal, all of the elements of direct and collateral cost. They may, however (and frequently) qualify the monetary values assigned to the various items by appraisal engineers. But when it comes to the non-physical assets the best that can be said is that many of the commissions have given this subject much time and thought. As a result the utilities are now receiving more favorable decisions than would have been possible five or six years ago.

With the possible exception of good will, and contract values, there is nothing unreal or ethereal about the non-physical assets. They are not, as so many people seem to think, added to the appraisal merely for the purpose of obtaining a maximum plane valuation to the ultimate end of squeezing the highest possible rates from the service subscribers.

Such items as cost of establishing business, franchise cost and cost of financing are real elements of the cost of building up any going utility business. They represent appreciable expenditures. In the writer's opinion the difficulty in the past of obtaining favorable rulings as to the non-physical assets has been due, not so much to doubt in the minds of commissioners regarding the existence of an "intangible" value as to the difficulty in allocating the expenditures involved, and to the lack of clear-cut, readily analyzed methods of estimating such expenditures.

The non-physical assets, it will be remembered, are: good will, franchise value, cost of establishing business, cost of financing, and value of contracts and agreements.

Good Will.—It is commonly conceded that good will can have no place in a valuation, for rate purposes, of a monopolistic utility. Lord Elden, in discussing good will, says:

"Good will is nothing more than the probability that the old customers will resort to the old place—that it involves an element of personal choice, and is inappropriate where there can be no choice, and therefore should be given no value."

In the telephone field, however, we are sometimes confronted with cases where, apparently, at least, there is an element of choice. Two telephone companies operating in the same town may have a large number of subscribers in common. But, even in this case, it is obviously out of the question to capitalize good will in the appraisal of the property, of either company, for rate adjustment purposes.

Circumstances might arise, however, where one of the companies would be willing to pay considerably in excess of the actual value of its competitor's property to eliminate its rival from the field. In such a case it is probable that the purchase price would include an allowance for good will, but undoubtedly such an allowance would take the form of a maximum valuation of the various elements of direct and collateral construction costs, rather than as a specific allowance set aside in the appraisal for good will.

Changes of ownership of utility properties are subject to approval of the state commissions, and it is highly im-

probable that any commission would ratify a sale where the element of good will was distinctly set forth in the purchase price.

A liberal-minded commission might, however, recognize that the property had a value over and above the actual value of the plant, and therefore allow the use of somewhat higher appraisal units than would otherwise be justified. But cases of this kind are exceedingly rare. For all practical purposes, good will is *not* to be considered a factor in public utility appraisal work.

Value of Contracts or Agreements.—It frequently happens that operating utility corporations have exceedingly profitable contracts or agreements with other utilities. A telephone company, for instance, may have an agreement with the local electric light company providing for the free use of the latter's poles throughout an entire section of a town. Usually an arrangement of this kind is reciprocal, the electric light company, in return for its concession, being granted the privilege of the free use of an equal number of telephone poles.

Undoubtedly agreements of this nature are exceedingly profitable to the beneficiaries, obviating, as they do, appreciable outlays for pole plant.

Attempts to assign a value to contracts and agreements, in rate-base appraisals, have met with the almost universal disapproval of courts and commissions, except in cases where the utility corporation can show that the securing or carrying out of such contracts involved actual cash expenditures.

One notable exception to this rule is found in the case of the Union Electric Light and Power Company of St. Louis. This company was permitted by the Public Service Commission of St. Louis to capitalize at 8 per cent the rentals saved through an agreement with the local telephone company involving the free use of the latter's poles. The total contract value assigned was $80,000.

Where actual costs are involved in the securing, or carrying out, of an agreement, as a rule, there is a little difficulty in convincing public utility commissions as to the propriety of including such costs in a rate-base appraisal. In the case of a telephone company, these costs usually consist of the salaries, car fare and incidental expenditures of the special agents employed in securing the agreement, and any payments the telephone company may make to the foreign company to cover the expense of rearranging the latter's interests to provide room for the telephone company on the poles that are to be jointly used.

The cost of rearranging an electric light company's wires and cables to facilitate joint pole use has been found to average from 50 cents to $1 a pole. The latter figure has been used in several recent appraisals.

Relation of Franchise to Value of Utility Property.—The valuation of franchises has long been a bone of contention between utilities and regulatory bodies. Looking at the matter solely from the standpoint of the utility, there would seem ample justification for contending that franchises have an appreciable monetary value.

The franchise is the foundation upon which the whole utility structure is built. Take away the franchise, and the most prosperous of properties becomes a mere mass of second-hand material worth only what the junk dealer can be induced to pay for it. Indeed, many items of plant, such as underground conduit, involving large initial expenditures and of great value to the company throughout its life as an operating utility, becomes absolutely worthless the moment the franchise is revoked.

It would seem, then, that the franchise must be one of the most valuable assets of a utility corporation, inasmuch as the very life of the company is dependent upon its preservation. On the other hand, from the standpoint of the commissions, and from that of the public they represent, there is an equally good argument for debarring, from a rate-base appraisal, all franchise values except those representing actual costs incurred in securing the said franchises.

Valuation of Franchises in Rate-Base Appraisal.—Franchises are in the nature of a gift from the people. It is obviously most unfair; therefore, to ask the people, or those of them who are utility patrons, to pay rates based upon a capitalization of their own gift.

This represents the general attitude of courts and commissions on the subject of franchise valuation; i. e., the value assigned to franchises in a rate-base appraisal shall be limited to the actual expenditures incurred in securing such franchises.

The question of franchise value affords an excellent illustration of the difference which may exist between value, or fair value, and value for rate-making purposes. In acquiescing to a commission's ruling that only actual costs shall be included in a rate-base appraisal as the value of its franchise, the company may contend—and very properly so—that the actual fair value of the franchise is far greater than any possible cost incurred in securing it, and the value thus assigned is a *rate-basis*, rather than a *true* value.

The equity of this method of evaluating franchises cannot be questioned. It would seem, however, that in return for waiving any claim for greater values, utility corporations should receive the maximum of protection at the hands of municipal and state regulatory bodies in the matter of franchise renewals, so long as the companies conduct themselves in such a manner as to warrant public confidence.

The legal cost involved in securing franchises has already been discussed. There remains, therefore, only the consideration of such other expenses as may legitimately be involved in securing the franchise. These are usually of a minor nature, excepting in the municipalities where it is customary to require prospective utility corporations to bid for their franchise privileges.

Cost of Establishing Business or Going Value.—Going value has been variously defined as "the cost of establishing the business," "the cost of acquiring an income," and "the capitalization of early losses incurred in connection with the development of the business to where it is capable of producing a fair return on the investment."

This phase of the subject of public utility appraisals is one that has always proven a thorn in the side of the appraisal engineer, and one that is usually rather difficult for the beginner in appraisal work to grasp.

There are several prevalent methods of deriving going value, and many explanations of the underlying theories have been advanced by eminent authorities. The following extract from the testimony of Kempster B. Miller, in an important rate case, presents the clearest explanation of going value which, in the writer's opinion, has yet been advanced:

"It is self-evident that a physical plant with a well-established business is worth more than the same physical plant without any business. This element of value, over and above the bare value of the physical plant, I have included under the heading of cost of establishing business. It is sometimes called going value. That such a value exists is indisputable, and, besides being a self-evident, fact has been upheld by courts of highest resort.

"In appraising the physical property, we proceeded upon the basis that the best measure of its value was what it would cost to reproduce it. I have followed this same procedure in appraising the value of the business attached to the physical plant by calculating as closely as possible what it would cost to reproduce the business that existed on the date of appraisal.

"I may, perhaps, make the theory upon which I proceeded clearer by a simple analogy. A man who desired to invest his money in a large office building might enter into an agreement with a contractor to construct the building and turn it over to him at a given date for a fixed sum.

"In thise case the amount so paid would constitute the cost of the physical

property. This amount, however, would be only a part of what the owner would have to pay in order to produce a building filled with tenants and established on a going basis. In order to fill his building with tenants and place it on an income-producing basis, it will be necessary for him to organize his operating force and sell his space, meanwhile operating the building, keeping it warm, running the elevators, and supplying the attendant janitor and other operating services.

"Instead of contracting for the bare building, the owner might include as a part of his agreement with the contractor the turning over of the building full of tenants and completely organized as a going concern. In this case it is perfectly obvious that the contractor could not deliver the building at as early a date nor for the same amount of money as when his task was confined to the production of the bare building alone.

"As the building approached completion he would be required to have agents at work securing leases from prospective tenants. He would be required to secure an adequate operating force for the building, consisting of a competent building superintendent and his office force, a building engineer and his subordinates, including elevator men, a suitable janitors' force, and, in fact, a complete organization necessary to keep the building warm and clean, and to carry out all of the other functions required. All this would have to be done before the tenants actually began to occupy the building.

"After the actual opening of the building, and until such time as the number of tenants required by the contract were secured, the contractor would be forced to pay all operating expenses, which at the beginning would be largely in excess of the rents received. As tenants were secured, the revenue would begin to grow, but it is probable that the contractor would be forced to give a certain amount of rent free during the early stages of the occupancy of the building. Such revenues as were received would, of course, flow to the contractor as an offset against the expense. It is inevitable, however, that the sum total of the financial results during the business development period would be a loss, and, together with the interest thereon, would become a part of the cost to the contractor.

"This total cost to the contractor, plus the contractor's profit, would be added to the investment of the owner at the time he took over the building. In this case the difference between this larger cost of the building full of tenants, and of the cost of the physical property alone, would constitute the cost of establishing the business, and would, in my judgment, be a good measure of the going value.

"In my appraisal of the telephone property under consideration, I have endeavored to estimate as accurately as possible what it would cost the company to reproduce the business and organization that were attached to the plant on the appraisal date in much the same way as in the case of the contractor just outlined, except that the company would act as its own contractor, without profit. It is believed that money would cost the company, under these circumstances, at least 8 per cent, and therefore that rate of interest has been included in the cost of establishing business.

"The cost of establishing business, as derived in the present appraisal, has been divided into three items:

"(a) Organization and development.

"(b) Selling service.

"(c) Net interest and operating expenditures during development.

"It is self-evident that an organization, from executives down to operators and laborers, could not be gathered together in the assumed reproduction of the plant and business without an expenditure of money.

"The expense incurred in training and schooling operators before they can become proficient enough to do useful work at the switchboards is one of many examples that might be cited, and no one at all familiar with the telephone business can deny that a skilled force of operators is a valuable asset. Again, at the beginning of service in a new plant it always occurs that until a certain number of subscribers has been secured no charge can be made, and the money spent during this period is a part of the cost of building up the organization.

"We have placed the cost of organization and development at $33,000, this being less than 2.5 per cent of the reproduction cost of the physical property. There is ample precedent for an allowance of this percentage, or a larger one, in computing this item.

"It has been generally recognized by courts and commissions that a certain amount of cost is involved in securing new subscribers. This cost resides in the salaries and expenses of solicitors, in advertising, and in the actual clerical expense of proper enrollment.

"It has been assumed that the total time required for reproducing the plant and the business would be seven and one-half years. I chose this period because it seemed to be the most economical one, and would bear the test of reason. It will be noted, however, from the schedule of expenditures, that the bulk of the plant expenditures was incurred during the first four years, and that the remaining three and one-half years were spent in a gradual rounding out of the property. The bulk of the plant expenditures during this later period was principally in the nature of minor extensions necessary to connect the subscribers as they were secured.

"This is the way that a plant would be built. To attempt to force matters by adopting a shorter construction and business-building period would be more likely to result in a greater rather than a smaller total investment.

"It was further assumed that the plant actually began to give service, and to charge, therefore, in the fourth quarter of the third year, or two years and nine months after the beginning of construction. By this means it has been possible, by applying common experience in the telephone business, to determine with reasonable accuracy what the investment would be in the plant at any time during the development period; and again, by applying common experience, to compute what the operating and other expenditures would be, what the revenue would be, and, finally, at the end of the period, what the net cost of all these operations would be at the time that the plant was fully organized as a going concern.

"In a tabulated statement we have shown the investment, the operating and other expenditures, and also the revenue, if any, during each quarter. This gives the basis for determining the deficit or profit for each quarter, thus making it possible to compute the net amount of money required for each quarter, the cumulative amount up to each quarter, and the interest thereon throughout the entire period.

"This total interest, thus computed, amounts to $586,051, but inasmuch as interest during construction, amounting to $78,018, has already been allocated to the cost of the physical property, this amount is deducted from the amount involved in the cost of establishing business. Again, during the entire period the total revenue of $1,128,743 exceeded the total operating expenditures of $743,694 by $385,049. This operates as a credit against operating expenditures, and therefore as a second deduction from the total interest account.

"These two deductions amount to $463,057, which, deducted from the total interest of $586,051, leaves a balance of $122,984 as the amount of net interest and operating expenditures during development.

"To summarize, the theory upon which I have proceeded in estimating the cost of establishing business was to assume, as is the case, that the town presented an average opportunity for a telephone enterprise; that the development of the property there in its hypothetical reproduction was carried out with ordinary care; and that a period of three years

(*Continued on page* 33.)

The Telephone Repeater

By F. J. DOMMERQUE
Fellow A. I. E. E.

Mechanical Repeater

For many years inventors have tried to discover a method whereby the speech after having used up all its vitality in the long flight over the line, might gain new energy to proceed on its journey and to be still strong enough at its arrival at the distant destination to fulfill its mission. One of the first repeaters consisted of a transmitter and receiver constructed as one piece of apparatus as is shown schematically in Fig. 1. The transmitter was placed in the primary circuit and the receiver bridged across the line. The talking current flows partly through the receiver and partly along the line. The current flowing through the receiver varies the resistance of the transmitter in front of it, and thereby an inductive action takes place from the primary winding of the induction coil containing the transmitter and battery upon the secondary winding in the line circuit, which causes an increase in the transmission. If both lines, the one to the east and the one to the west, are perfectly balanced, no potential will exist in the bridge containing the receiver and we will have a satisfactory transmission of speech. But if the impedance of one side of the line is noticeably higher than the impedance of the other side, a difference of potential will be created in the bridge, which acts detrimentally on the transmission; a tone is heard in the receiver, commonly known as "singing." In practice it is extremely difficult to avoid irregularities in both sides of the line. Perhaps if such a repeater could be placed exactly in the middle of a uniform line, good results might be obtained. But even then the difference in strength of the voices of the parties talking might disturb transmission, and still more so the differences in the lengths of the local lines at both ends of the repeatered line.

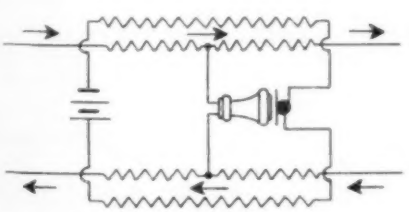


Fig. 1

S. G. Brown in England constructed a mechanical repeater consisting of a carbon transmitter enclosed in a casing. This he connected with the tongue of a very sensitive magnetic relay. Such a combination has the drawback that the inertia effect produced by the movement of the relay tongue will distort the speech. Apparatus of this kind requires a careful adjustment to its most sensitive position, the least shaking or vibration may change the adjustment again. All attempts to construct a mechanical repeater were abandoned when the electron tube made its appearance.

The Electron Tube Repeater

The qualifications an electron tube must possess to make a good repeater are the following: The tube must be thoroughly evacuated. The grid must operate on a negative voltage in order to work upon the straight part of the characteristic curve illustrated in Fig. 2, between the two bends, because this straight line indicates uniformity of relation between plate current and input voltage to the repeater, this uniformity being essential to obtain an amplification without distortion of the speech. To effect a negative grid voltage, the grid battery is inserted in the grid circuit with its negative pole connected to the grid. It signifies a satisfactory vacuum if there is no grid current when the grid voltage is negative.

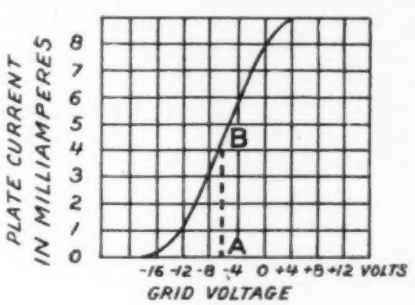


Fig. 2

The vertical line AB in Fig. 2 drawn midway between the zero point of the grid voltage and the point where the projection of the point of the termination of the straight part of the characteristic hits the grid voltage axis indicates the most favorable voltage for the grid battery of the tube for which Fig. 2 gives the characteristic; in the case of our example, 6 volts.

To give long life to repeater tubes oxide-coated filaments are favored because they require comparatively little current for heating.

The fundamental circuit connections of a repeater tube are given in Fig. 3. The grid circuit is connected to the line by means of an input transformer T_1 to adapt the repeater to the line conditions. The voltage fluctuations of the weak incoming current act upon the grid circuit and cause similar fluctuations in the plate circuit. The fluctuation A shown in Fig. 4 may represent the fluctuation in the voltage of the grid circuit caused by the incoming alternating current; B may represent the continuous current flowing in the plate circuit; C will then represent the form given to this current by the voltage fluctuations in the grid circuit, and D shows what form they take after passing through the output transformer T_2. The curve D has the same wave formation as the curve A, but the amplitudes are considerably greater. In actual performance the process of amplification of speech is more complicated, but the above illustration may help to form an idea of what is going on in the tube.

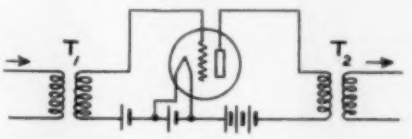


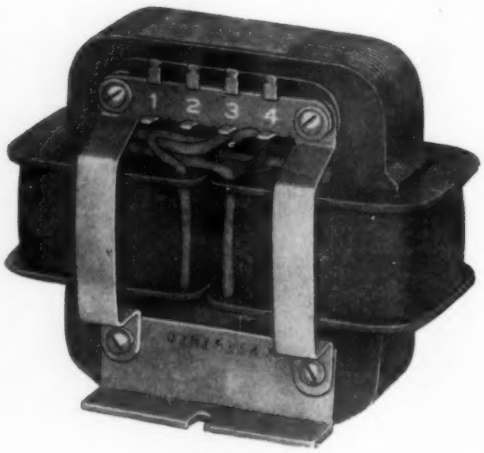
Fig. 3

The arrows in Fig. 3 indicate that in the repeater the speech amplification takes place in one direction only, namely, for transmission from west to east. It is, however, a commercial requirement that conversation can be carried on both ways. In order to accomplish this, a number of more or less efficient methods have been devised, of which the bridge method has been found the most practical. In this method the repeater circuit is connected to the line by means of a bridge or differentially wound repeating coil as shown in Fig. 5 and 6. Fig. 5 gives the circuit of what is known as the 21-type repeater, because it works two ways with a one-element repeater, while Fig. 6 illustrates a circuit which works also both ways but with two elements, one for each direction, whence the designation 22-type repeater. We will describe the 21-type first.

When the current comes in over the line west, it splits into two parts; the one a part, which is very small, goes out over the line east and dissipates; the other part flows into the input circuit where it is amplified and proceeds to the output coil, where it splits again, the useful part goes out on the line east, the part going west is not used. In this repeater circuit the line east is balanced against the line west. The potentiometer serves to regulate the amplification gained by the tube. The retardation coils will prevent the fluctuations in the source of current to affect the proper action of transmission. The resistance in the filament circuit keeps the heating current at its proper value.

It Took Twenty Years To f

Talk-Through and Ring-Through



Type 1

This coil is especially designed for toll line use in phantom and simplex circuits. It is exceedingly efficient in transmitting both ringing and voice current frequencies—the high frequency losses being less than 0.26 miles of standard cable.

Made with closed type core of silicon steel laminations. The parallel windings are perfectly balanced and are interconnected in such a manner that maximum protection from lightning is secured. This feature permits its use on intermediate and grounded phantoms as well as terminal and metallic phantom circuits. Furnished with cross-talk-proof cover. (Not illustrated).

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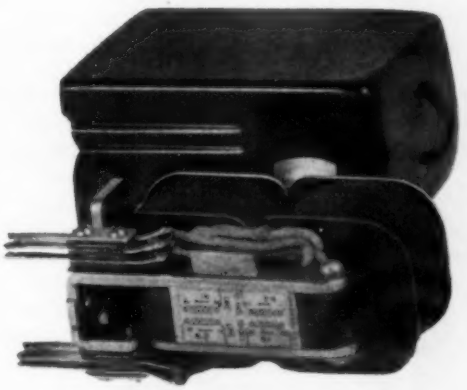
Talk-Through Only and Non-Ring Through



Type 4—Talk-Through Only
Type 5—Non-Ring Through

Both of these coils are designed for mounting on the relay rack and occupy only the space required for two line relays.

Type 4 is of the closed core type and has a wide field of application in common battery circuits for battery feed, isolation of circuits, etc.

Type 5 is of the open core type and effectively bars all ringing currents. Used in Universal and magneto cord circuits.

Furnished with cross-talk-proof cover. (These coils can also be supplied with a mounting similar to Type 1, if desired.)

erican Company, Inc.
64th Str CHICAGO, U. S. A.
Warehouse: otte Streets, Kansas City, Mo.

The 22-Type Repeater Circuit

A better method for two-way operation is the two-way two-element (*22*) circuit, which uses two tubes, as shown in Fig. 6. In this circuit each repeater element amplifies the transmission in the opposite direction. Each line is balanced by a separate balancing network. Here as well as in the 21 repeater particular care must be taken that both lines, west and east, have practically the same impedance over the entire range of telephone frequencies. As the 21 repeater circuit contains less apparatus than the *22* circuit and consequently is cheaper to build, its use would be preferable under equal efficiency conditions. This is only the case, however, when the line is not long enough to demand more than one repeater in series. With a number of repeaters on the same line a reaction of one repeater upon the other takes place which would cause easily distortion or singing in the 21-type repeater circuit.

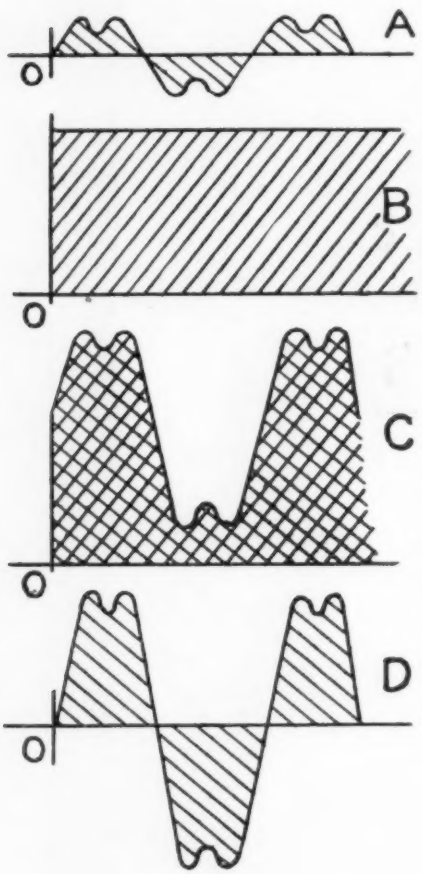


Fig. 4

From Fig. 6 it can be seen how the lines west and east are balanced by their corresponding balancing networks. The current coming in from the west splits into two parts, the smaller part goes into the balancing network while the larger part flows into the input circuit. A filter is shown in this circuit which serves to keep out telegraph and other disturbing currents. Such filters are also used to advantage in the 21-type circuit; they have, however, been omitted in Fig. 5.

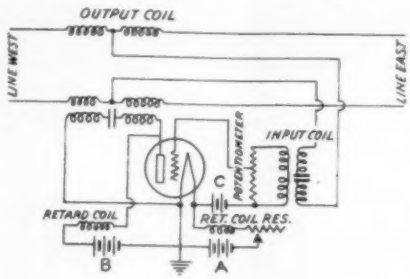


Fig. 5

The input current is amplified and sent east by way of the output transformer. If the balancing network "West" fully balances the line "East," that is, if the balancing network "West" has the same impedance as the line "East," no difference of potential will be produced in the input circuit of repeater E and consequently no singing will be possible. The same would be the case for transmission from line "East" to line "West." Therefore, perfect transmission would be obtained, but with the reservation that the two balancing networks really effect a balance. But a perfect balance is practically impossible, there is always some unbalance if ever so slight. If, however, one of the balancing networks balances its own line exactly, no singing need be expected from any unbalance between the other balancing network and its line, even if the unbalance is of some considerable magnitude. Consequently always two unbalances must prevail at the same time to produce singing. This is of importance when one of the lines is loaded, but not the other line. It seems nearly impossible for a balancing network to follow the variations in impedance always met with in loaded lines. A suitably designed balancing network will, however, afford a sufficiently accurate balance to avoid a distortion of transmission. It must be understood that it is not necessary for the balancing networks to stimulate all the transmission characteristics of the actual lines, as long as they have the same impedance characteristics.

It will be noticed from Fig. 5 and 6 that the transformer coils are divided into two symmetrical windings, and that the repeater circuit is connected to the middle of the transformer windings. This is done to avoid the ill effects of generation of continuous oscillations, which would appear if the two parts of the amplified current going out over the line were not equal in quantity and phase over the voice frequency range. When several repeaters are placed on a line in series the "echo" effects render the application of 21-type repeaters practically prohibitive. Therefore the use of the 21-type is restricted to short lines and terminals and to the four-wire repeater circuit, the arrangement of which we will now explain.

The Four-Wire Repeater Circuit

Ordinarily not more than five repeaters are placed in series on a line. If these repeaters could be placed exactly equidistant there might be used six on the same line. Taking into account the impossibility of simulating perfectly a loaded line by balancing networks a gain of not more than $\beta l = 1.5$ or 13 TU can be expected between any two *22*-type repeaters of the oxide filament type, the equivalent distance between two adjacent repeaters depending on the size of the line conductor. Any gain by amplification can be measured (the same as a loss by attenuation) in transmission units, which may be expressed by the transmission constant βl or by TU. In general, a repeater makes up the loss in line attenuation from the preceding repeater or from the terminal, if the repeater in question is the first one in the series; thus leaving at the end terminal the difference between the total attenuation and the total amplification in the line. This is illustrated in Fig. 7 for a line with the terminals A and E, and three intermediate *22*-type repeaters the distances between repeaters being assumed equal and the attenuation in each section equivalent to a $\beta l = 1.5$ or 13 TU, and the distance between A and the first repeater and also between the third repeater and E equivalent to a $\beta l = 1.3$ or

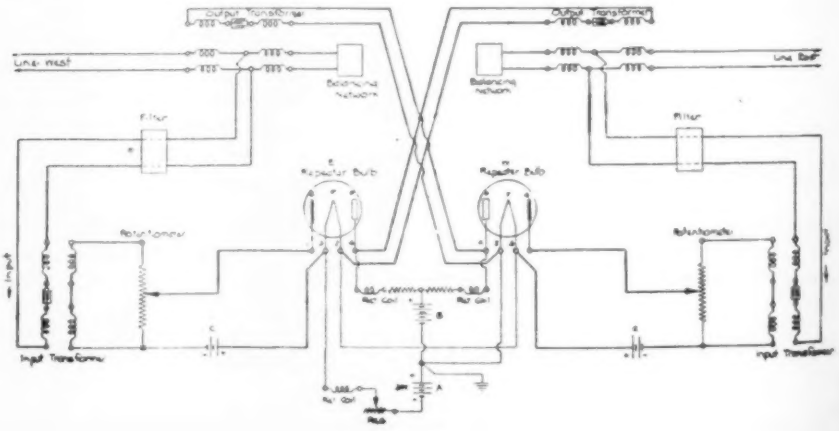


Fig. 6

11.3 TU. The vertical scale or ordinates gives the attenuation levels indicating the losses by attenuation or gains by amplification at each point of the line. At the terminal E the residual attenuation equivalent is $\beta l = 1.1$ or 9.6 TU, which is the difference between the total attenuation and the total amplification.

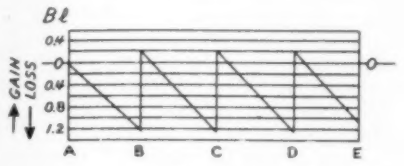


Fig. 7

In actual practice the distances will never be as uniform as shown in Fig. 7, and the attenuation levels will be correspondingly higher or lower. In practice the attenuation levels are determined for the average frequency of the talking current assumed as $f = 800$ periods per second. As the higher frequencies in the speechrange from 200 to 3000 frequencies are more attenuated than the lower frequencies an equalization may be effected by greater amplification, that is, by the proper design of the transformers in the repeater circuit, if the distortion is only slight. In long cable circuits, however, the distortion may exceed an acceptable limit; in such cases a supplementary network may be bridged across the line side of the transformers, such a network consisting of coils, resistances and condensers, similar to the supplementary network shown in Fig. 13 on page 18 of the June TELEPHONE ENGINEER. A network suitable for a loaded cable with several 22-type repeaters in series is indicated in Fig. 8.

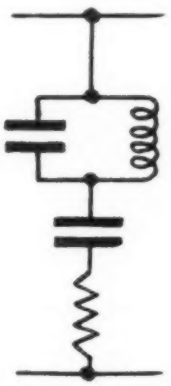


Fig. 8

If a long distance circuit is of such a length that five or six 22-type repeaters would be insufficient to overcome the attenuation, recourse is had to the so-called four-wire repeater circuit, of which Fig. 9 gives a general idea. This circuit is made up of two metallic circuits, whence the name "Four-wire." The two metallic circuits (phantom circuits may also be made use of) do not necessarily extend over the entire line over which transmission is to be effected, they may be inserted into any long distance line wherever there is need of it. They are connected to the subscriber's or any other two-wire line by means of a bridge similar to the bridge in the 22-type repeater circuit as shown at A and E in Fig. 9. There is no other bridge required in the intermediate repeaters marked R, which in the four-wire circuit are of the 21-type, which may be, however, supplied with supplementary attenuation networks to avoid distortion. Balancing networks to balance the lines west and east are only necessary at the two end stations A and E where the four-wire circuit is joined to the two-wire circuit.

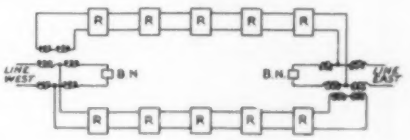


Fig. 9

Application of Repeaters

From all that has been said before it becomes evident that the application of the vacuum tube as an amplifier has caused a revolution in the construction of long distance lines. In the first place the advantage of the repeater induces to a more economical perusal of the existing long distance system and in the second instance it presents an opportunity to build new extensions cheaper than ever before. In order to secure these advantages particular attention must be paid to the toll and long distance wire plant or rather to its condition.

Already in loading lines it was necessary to take great care in line construction, principally in the aerial wire plant; how much more care will be required when in addition the repeaters have to be taken care of. As far as open wire lines are concerned uniformity is the principal requisite. The balancing of all parts of the line by balancing networks is a difficult problem to solve. There are not only open wire lines, which alone could be kept fairly uniform, but in connection with open wire are the short pieces of cable serving to bring the toll and long distance lines into cities and towns or to pass these lines through communities. Where circuits consist partly of cable and partly of open wire it is hard to match the impedances, besides the disadvantage that cable circuits are less efficient at the higher frequencies causing losses in transmission. Neither can with open wire nor aerial cables the influence of climatic conditions be left out of consideration, nor can the distances between loading coils be kept exactly alike; it is hard work to transpose the loaded lines properly and protect them against the action of high voltage transmission lines. All these difficulties are magnified by repeatering loaded lines, as amplifying the speech means also amplifying all disturbing and distorting elements. The easiest way out of these difficulties would be to cable all the lines. But this is not so easy to accomplish as there is too much money involved in abandoning the extensive open wire lines now existing, but the transformation is progressing, although there are open wire lines, and long stretches of them, where a transformation may never pay on account of the sparsely settled country over which such lines pass. However, it pays amply to repeater them, as the New York-San Francisco line shows. This line had, when loaded only, a transmission equivalent of $\beta l = 6.867$ or 59.3 TU. Inserting in addition repeaters into the line brought this equivalent down to one-third of the above figure. Later on it was found that on such long lines the uniformity of the line and the velocity of transmission were of greater importance for the limitation of the transmission equivalent than the attenuation. The velocity of transmission of the voice currents over the line amounted to 0.07 second from end to end. Removal of the loading coils from the open wire line and improving the repeater installation reduced the propagation velocity to 0.02 seconds. The attenuation, however, was increased thereby; without the repeaters the attenuation would have been $\beta l = 14.5$ or 127 TU, but the repeaters brought the transmission equivalent down to $\beta l = 1.45$ or 12.7 TU; this means for the same amount of speech energy expended at the sending point practically seven times as much energy is obtained at the receiving point after repeaters are inserted in the open wire line as before, when the line was only loaded. The increased velocity avoided "echo" action, of which we will speak some other time, also of the speech energy or power received at the end of the line.

The conclusion may be drawn from all this that repeaters in open wire lines render loading of these lines unnecessary; it all depends whether it pays to repeater the lines; that is, whether the lines are long enough to warrant repeaters, else loading would still find a useful place.

It is different with cables. In non-loaded aerial lines, that is, in open wire lines, the attenuation increases with increasing frequency but the increase rises so slowly that the difference in frequencies will not disturb the quality of transmission, at least no noticeable distortion of speech is produced. If the open wire line is loaded a considerable decrease in attenuation will be experienced for the lower frequencies at least up to 800 periods per second. For frequencies from 800 to 2000 periods per second the decrease is still prevalent, but it does not go on uniformly, with approach to the frequency of 2000 periods per second the improvement is lessened to a greater extent, the difference between attenuation in the loaded line and in the non-loaded line

becomes more accentuated, which indicates that the frequencies composing the speech range are not transmitted uniformly, hence they produce more or less pernicious distortion. Above 2000 periods per second the attenuation soon becomes infinitely large, that is, the cut-off frequency is soon reached. It may be added that loading an open-wire line decreases considerably the transmission velocity, which in some cases falls to one-third.

Observing the behavior of an ordinary non-loaded paper cable it will be noticed that the attenuation increases greatly with increasing frequencies. Loading the cable gives the first range up to 800 periods per second an increasing difference in the attenuation, which reaches at 800 periods a point where the attenuation value is one-half of the value for the non-loaded cable; from that point on, however, the attenuation during the second frequency range remains nearly constant. Here also will the frequencies die out at the cut-off frequency point; the heavier the loadings, the lower will be the cut-off point. The circumstance that in the second speech frequency range all frequencies are transmitted nearly uniformly shows that in cables the distortion due to loading is not only improved in comparison with open wire lines but is nearly avoided. Hence loading of open wire lines increases distortion, but loading of cables decreases it. At the same time an increase of voltage in the circuit decreases the transmission velocity but increases the possibility of cross-talk.

As repeaters increase the transmission of speech, they also amplify the distortion already present in loaded open wire lines, while the amplification of the distortion present in loaded cables to an extremely small degree only will not cause any detrimental effects. Without repeaters the introduction of loading coils in open wire lines furnishes mostly sufficient inductance to keep the distortion in limits. Wherever open wire lines are long enough to justify the expense for repeaters, the total results are best without loading; in cables, however, repeaters plus loading gives the best results.

Chambersburg, Pa.—One carload of lead covered telephone cable arrived recently for the C. V. Telephone Company, to be used in replacing cable so badly injured during the storm of April 27 as to make it practically worthless from a service standpoint.

The Southwest Telephone Company has applied to the Oklahoma Corporation Commission for permission to purchase telephone exchanges at Mountain Park, Lone Wolf and St. Louis, Pottawatomie County, Okla., according to B. Richardson, telephone engineer of the commission.

Harry B. Thayer Retires from Board of American Tel. & Tel. Co.

The resignation of Harry B. Thayer as Chairman of the Board and a director of the American Telephone & Telegraph Company was accepted August 15th at a meeting of the Board of Directors at Boston, and an amendment to the by-laws was voted discontinuing the office of Chairman.

Jeremiah Smith Jr. of Boston was elected a director to succeed Mr. Thayer. Mr. Smith, an economist of note, was appointed Commissioner General of the League of Nations for Hungary on May 1, 1924, and conducted his task of rehabilitating Hungarian finances so successfully that Hungary was released from League supervision on June 30, 1926. Before that time Mr. Smith had been a counselor to the Treasury Department of the American Mission to Negotiate Peace.

In a statement issued at the close of the meeting, President Walter S. Gifford said:

"After nearly fifty years of continuous service in the Bell System H. B. Thayer, Chairman of the American Telephone and Telegraph Company, has retired.

"When Mr. Thayer went to work for the Western Electric Company in 1881, soon after his graduation from Dartmouth College, that company was doing an annual business of about three-quarters of a million dollars. He became President of the Western Electric Company in 1908. When he left to become President of the American Telephone and Telegraph Company the annual business of the Western Electric Company had grown to about $150,000,000.

"When Mr. Thayer resigned as President of the American Telephone and Telegraph Company over three years ago to become Chairman it was with the idea of gradually relinquishing his responsibilities to the interests he had served so faithfully and long. Now he feels he has earned his freedom from these business cares.

"During Mr. Thayer's connection with the Bell System the investment, which was about twenty-five millions at the time he went to work in the manufacturing company, has increased to over three and a half billions.

"Mr. Thayer has always been acquiring friends among the younger men, so that the best wishes of thousands of his present associates in the American Telephone and Telegraph Company and its affiliated organizations are extended to him now, and will be his in the years which are to come.

"In accepting Mr. Thayer's resignation as Chairman and director of the American Telephone and Telegraph Company the directors unanimously expressed their high appreciation of his invaluable services in the development and success of the Bell System."

The regular quarterly dividend of $2.25 a share was declared, payable on Monday, Oct. 15, to stockholders of record at the close of business on Thursday, Sept. 20.

Mr. Thayer's career coincides within a few years with the entire history of the telephone, for it was on March 10, 1876, that Alexander Graham Bell summoned his assistant in the first telephone conversation in history: "Mr. Watson, come here. I want you."

Parisian Telephone Troubles

Commenting on the Parisian telephone system which is owned and operated by the government, the Paris Times says:

"Often enough, a machine will be out of order for days or weeks. The administration does not press itself to make repairs, as would a private company. Nor does it offer any payment to compensate for interruption of service.

"When a subscriber, unhopeful but desirous of a means of expressing his feelings, appeals to the complaint department, he must pay for the call.

"These are some of the reasons why most Parisians would rather walk a mile than go through the difficulties of a telephone call. These are reasons why thousands of apartments which should normally be equipped with telephones do not have them. These are reasons why the government probably makes less from its monopoly than it would receive in taxes from an efficient private company willing to give service."

System Changes Hands

Devils Lake, N. D.—The Dakota Public Service Company took over the telephone system here of the Otter Tail Power Company, which it purchased recently, and from now on the new company will render this service to the people of Devils Lake. The company intends to construct a two-story building in which to house its activities here.

Coolidge Favors State Regulation

Press dispatches August 17 announced that President Coolidge is convinced that regulation of public utilities should be left largely in the hands of state legislatures. It is also stated that President Coolidge, in his annual message to Congress in December, will deal with the question whether in his judgment the Federal Trade Commission investigation of utilities indicates the need of any national legislation.

Recent Toll Cable Construction and Its Problems

By H. S. PERCIVAL

Engineer of Outside Plant, Long Lines Department, A. T. & T. Co.

In the work of the Bell System to provide communication facilities, one of the recent outstanding developments has been the rapid extension of toll cables. The map shown in Figure 1 illustrates some of the more important toll cables now in service or under construction but requirements for additional facilities will necessitate numerous extensions and new installations in other parts of the United States. It is expected that for the next few years additional toll cables will be installed at the rate of more than 2000 miles per year.

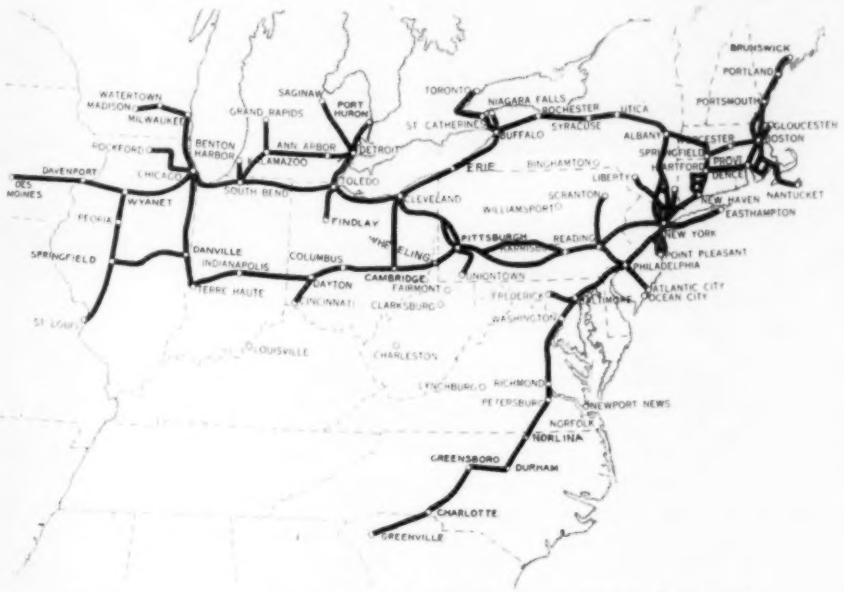


Fig. 1—More Important Cable Now in Service or Under Construction

In carrying out this program the importance of the co-ordinated efforts of various groups cannot be over-emphasized, that of the engineers in formulating the plans, the careful consideration and decisions of executives in approving these plans, and the skilled work of the manufacturing and construction forces in making and installing the cables. Nor should the importance of maintaining this network of cables be over-looked since it requires the cooperation and effort of many trained people to provide the continuous service which is vitally necessary to the industrial and social structure of the country.

There are necessarily many difficult problems involved in toll cable construction and maintenance, from the selection of suitable routes, on through the installation work, to the provision of the delicate and extensive apparatus required in the operating and repeater stations to provide satisfactory communication through the circuits contained therein. This article, however, discusses only some of the more recently developed and unusual features involved in the work of installing such cables.

Delivery of Material

One of the difficult operations in the installation of toll cable is the delivery of the reels of cable and loading coil pots to the job, where the cable is to be located in rough or mountainous sections. In some cases the reels contain as much as 750 feet of cable, 2⅝ ins. in diameter and weighing about 8 pounds per foot. This, with the reel, gives a gross weight of approximately 3½ tons under such conditions. Along improved roads the reels and loading pots are carried on trucks or specially designed "trailers." On highways the trailers are usually hauled behind trucks although in some cases where steep grades are encountered caterpillar tractors are used. In the case shown the reel is being taken across a small stream.

Where the cable is located on private property, particularly where heavy grades or soft ground conditions are encountered, it is necessary to use a trailer equipped with caterpillar tractors.

Pulling in the Cable

Motor trucks equipped with winches, or tractors similarly equipped, are generally used for pulling cable into the ducts in underground construction or into rings on the suspension strand in aerial construction. In underground work the reel is

Fig. 2

usually mounted on jacks in a suitable position near the manhole, the end being fastened to the pulling line by a woven wire grip, the pulling line having previously been threaded through the ducts.

In aerial work the cable is usually pulled directly from the trailer as shown in Figure 2. This operation has been materially helped by the development of a cable guide. This guide is temporarily clamped to the suspension strand with the curved end toward the reel. The curved or belled end guides the cable smoothly into a horizontal position along the suspension strand and the straight barrel beyond the curved end straightens out any bends in the cable.

Loading

Practically all toll cables are "loaded."

Fig. 3

This loading consists of coils of wire connected into the circuits at regular intervals throughout the length of the cable, the coils being contained in iron pots or cases of various sizes depending upon the number of circuits it is desired to load at one time. Some of the larger pots are approximately 2 ft. 3 in. in diameter by 5 ft. high and weigh more than a ton.

In underground work the pots are lowered into the vaults or manholes with suitable tackle. In aerial cable work, the present practice is usually to construct a 2-pole fixture with channel iron cross members as shown in Figure 3. The channel irons are usually placed from 9 to 12 feet above the ground but in some cases local conditions necessitate a higher fixture. In either case, special rigging is required to raise the heavy pots into position.

On aerial loading fixtures the pots are bolted to the channel irons with tie rods and the stub cables with which the loading pots are provided, are spliced into the main cable as shown in the figure. In this case, provision has been made for six pots which would fully load the cable, but recent developments using permalloy in loading now permit the inclusion of a sufficient number of loading coils in a single pot to completely load with two

Fig. 4

pots a full size cable (one containing about 150 quads or 300 pairs of 19 gauge conductors or the equivalent cross section in conductors of other gauges).

Where aerial loading fixtures are unusually high or if the soil conditions do not give very secure footing, the fixtures are strengthened with transverse guys or braces.

Splicing Aerial Cable

In splicing aerial cable a platform is swung from the suspension strand and a splicer and his helper carry out the operation from this platform, as shown in Figure 4. In cold or rainy weather, a tent arranged on a frame which is also fastened to the suspension strand, is placed over the platform. The ladder shown in this picture not only serves as a means of reaching the platform, but is lashed to the suspension strand before the platform is placed, in order to relieve the strain on the strand, due to the platform and the weight of the men and tools, which would otherwise sag down the strand and tend to leave excess cable in place after the splice was completed.

Soldering Wire Joints and Boiling Out

In toll cable work, both aerial and underground, the wire joints are made by twisting the wires together, after which the joint is carefully soldered. The joint is then covered with a short length of cotton sleeving, impregnated with paraffin.

Previous to splicing, the sheath is removed for two feet or so from each end of the cable and paraffin at a temperature of 375° to 390° is poured over the exposed conductors to prevent the absorption of moisture. This operation is repeated once or twice during the progress of making the splice, in order to insure the very high degree of insulation necessary for satisfactory operation of the circuits, when the cable is placed in service.

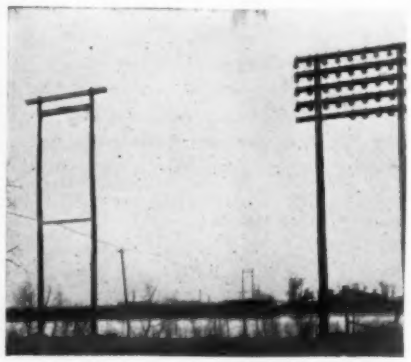


Fig. 5

Long Span Crossings

Submarine construction is employed in crossing streams where the width or other conditions are such that aerial construction would be unduly expensive. However, in crossing streams of moderate width, aerial construction is frequently used and in such cases a catenary method is employed. Figure 5 shows a long span crossing on the Terre Haute-Chicago Cable at the Kankakee River for both open wire and cable. In this case, on account of the moderate width of the river, and the fairly high banks on each side, it was practicable to use wooden pole fixtures. However, where the height of the fixtures would be more than 50 to 60 feet, it is usually desirable to erect structural steel towers. Figure 6 shows a crossing of this type on the Albany-Buffalo Cable at Mud Lock, the fixtures being self-supporting against transverse strains, but guyed longitudinally to take care of the weight of the cable.

The long span crossings illustrated in the figures mentioned are at present carrying only one cable but have been constructed to provide for an ultimate of three cables and are of the following lengths between supporting towers:

Terre Haute-Chicago Cable.....548 feet
Albany-Buffalo Cable.....561 feet
Pittsburgh-St. Louis Cable.....635 feet

Aerial Entrances at Repeater Stations

A problem which has required careful consideration in connection with aerial cable construction has been to provide a suitable entrance at repeater stations. Where only one cable is concerned, the problem is fairly simple, but usually it is necessary to provide for two, or possibly three cables which would involve four or six cables between the terminal pole and the building. This arrangement consists of a light lattice steel framework between the terminal pole and the side of the repeater station.

Pressure Testing

One of the most important recent developments in cable work in this country is the pressure testing of cables to detect the presence of defects in the sheath, which would permit the entrance of moisture. This is now being carried on extensively with very satisfactory results.

The use of air for this purpose requires somewhat elaborate apparatus for drying it and there is also the possibility that with the most careful precautions, the air would contain some trace of moisture, which would tend to lower the insulation. At present, oil pumped nitrogen and carbon dioxide are used. Figure 7 shows a cylinder of carbon dioxide and the required auxiliary apparatus set up at a manhole.

The usual method of pressure testing

Fig. 6—Long Span Crossing at Mud Lock Near Senecca Falls, N. Y., on the Rochester and Syracuse Cable Span. 562 Feet. Towers 65 Feet High.

toll cables during installation is to apply pressure to each loading section before the loading coils are spliced in. These loading sections are about 6000 feet in length and the ends are sealed with a lead cap, as shown in Figure 8, in connection with certain electrical tests on the cable so that the arrangement is very convenient for pressure testing. The gas is admitted at a pressure of about 30 lbs. per square inch at one end of the loading section through a temporary connection

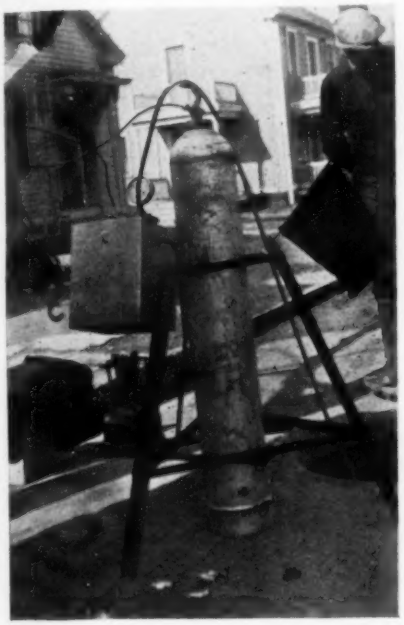


Fig. 7

soldered to the cap. A pressure gauge may also be connected to the cap, as shown and a similar gauge connected to the cap at the other end of the section or readings may be taken by means of hand gauges from temporary connections.

Gas is admitted until the gauge at the far end shows some evidence of pressure at which time the gas is shut off, the cylinder removed and the section left for at least six hours or over night. At the end of this time, if there are no defects

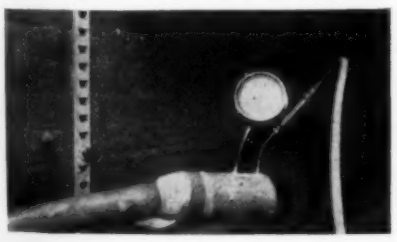


Fig. 8

or leaks in the sheath, the pressure at the two ends should be approximately equal. Leaks are usually indicated by the failure of pressure to build up at the far end and can sometimes be located by the sound of escaping gas as the cable is inspected at intermediate manholes. In the case of a very small defect where this method would not be effective, the leak can usually be localized by placing gauges at intermediate points from which a pressure gradient can be determined, the low point giving the approximate location of the leak. The exact location of the defect, if in a manhole, can be found by wiping over the cable and the splicing sleeve with soap suds. The formation of bubbles indicates the escape of gas. If the trouble is in the duct line, gauge readings taken in various manholes in the vicinity of the trouble will usually indicate the particular length involved. The same general method is used on aerial cables, except that evidence of the leak by the hiss of escaping gas is more easily obtained, and the use of soap suds can be carried out completely since the cable is entirely exposed.

When two or more loading sections have been tested and found satisfactory, the loading coils are spliced in. These splices are then tested by admitting gas at the loading point and wiping the splice with soap suds. The gas tends to flow away through the cable but sufficient pressure can be maintained to give very reliable indications.

The use of pressure has also been used to advantage in submarine cables, and in a recent case the presence of a defect was noted by the drop in pressure, the location of the defect determined by bubbles rising to the surface, and the cable raised and repaired without any of the conductors having been in "trouble."

General

In the foregoing no attempt has been made to give an adequate discussion of the entire subject of toll cable construction, but rather to touch in a very brief way on some of the more unusual and difficult features now encountered in work of this kind.

Practical Suggestions for Plant Valuation

(*Continued from page 24.*)

would be required to reproduce the bulk of the property, and a total of seven and one-half years would be required to reproduce all of the business and make the gross and net incomes equal to what they were on the specified date.

"Under these circumstances, the deficit for the first year would necessarily, with reasonable interest, be required to be carried over to the next year. The deficit at the end of that year would necessarily be added to the previous one, and, with interest thereon, carried to the next year, and so on from year to year, the deficiency decreasing each year until finally the current income would be more than sufficient to balance the current liabilities, and at the end of the period would be as they were at the date of appraisal. In this state of equilibrium the deficiency account would seem to be a fair measure of the value of the mature going business.

"The three items in the total cost of establishing business—$33,000 for organization and development, $44,751 for selling service, and $122,984 for net interest and operating expenditures during development—amount to $200,735. This is slightly less than 15 per cent of the total reproduction cost of the physical property, which, measured by all standards of comparison that I have been able to secure, is conservative.

"Of the many methods that have been proposed for calculating going value, or cost of establishing business, I have applied all that seem in any wise reasonable to the facts in this case, and they have almost universally produced a larger value than the one herein presented. For instance, in the recent case before the Board of Public Utilities Commissioners of New Jersey, involving the telephone rates at Camden, the method advanced by the commission, when applied to the present case, results in a figure of $211,342, which is 5 per cent higher than the figure set up in my appraisal."

As previously intimated, the all important subject of Unit Costs will be discussed in the October issue. It is difficult to place too much emphasis upon the importance of this phase of the subject of telephone appraisement—for, if the unit costs are faulty, the appraisal is bound to be wrong, no matter how carefully the field count may have been made.

Earlsboro and Strong City Telephone Plants Improved

Skiatook.—The Standard Telephone and Telegraph Company, with headquarters here, has just completed rebuilding of the outside plant of its telephone system at Strong City, according to W. O. Mills, division superintendent. Improvements include placing of about 2,000 feet of cable, a car of poles and complete rewiring of all subscribers' stations. Material is on the ground for complete rebuilding of the outside plant of this company at Earlsboro, to include placing of about 5,000 feet of cable and entire rewiring of all subscribers' stations. Addition of these facilities will be a real factor in improving service at these points, according to Mr. Mills. The Standard Telephone and Telegraph Company has twenty-one exchanges in Oklahoma and seven in Texas.

United Telephone Co. of Abilene, Kan., Asks Rate Increase

Substantial increase in rates is being asked by the United Telephone company of Abilene, Kansas, application having been filed with state public service commission. Increase of individual business rate from $2.75 to $4.00 a month; individual residence rate from $1.75 to $2.25, and party line increases in proportion.

LINE AND DESK

SOME MORE PRACTICAL QUESTIONS—AND THEIR ANSWERS

In the July number of TELEPHONE ENGINEER the writer submitted a budget of questions to which he had been able to supply the answers. Here is another list which may supply information to others than those asking the questions. The door is open; if there are others who have questions let them come in. If there are readers who have additional information on these questions let them send it along so that all may have the benefit.

Question D—How can I build a test equipment for testing repaired telephones thoroughly before putting them in service? I am operating a small country exchange and do not want to go to too much expense. I have repaired several telephones and they would talk and ring good on our shop line, but would not work on a rural line.

Answer: Let all readers get together and make this a good one.

To the subscriber of TELEPHONE ENGINEER who sends in a sketch of the best test equipment, considering the lowest amount of money outlay, the writer will mail prepaid a good reliable test equipment for this purpose.

This is not a contest on the publisher's part, but an offering of the writer to see more men in the field get together and does not include engineers.

Question E—What is the inductance of a set of 2500 ohm ringer coils? I would like to use them on some equipment for a radio set.

Answer—The inductance of a 2500 ohms ringer is approximately seven henrys.

Question F—I have some rural lines which are equipped with 5 bar 1600 ohm-bridging telephone. For a long time it did not bother when a subscriber left his receiver down, but now I am having lots of trouble of ringing subscribers from this cause.

Answer—Your trouble is due to the condenser being short-circuited. Lightning has punctured the condenser which is in series with the receiver and secondary winding of the induction coil.

The condenser can be treated by cutting a receiver and battery in series, that is to say, take a cell of dry battery and connect one side of the battery to one side of the receiver, then connect a wire to the other side of the battery, to the other side of the receiver cord connect a short piece of wire.

Be sure the switch hook of the telephone is down, then touch the two wires from your battery and receiver to the terminals on the condenser, you will get a click.

If you get a click in the receiver every time you touch the wires to the condenser terminals the condenser is short-ciruited.

But if you do not get a click only when you reverse the wires when you touch the condenser terminals the condenser is good.

Watch for future issues of TELEPHONE ENGINEER as the writer expects to contribute sketches of test circuits and equipment, also descriptions of how to build them.

(Editor's Note: In reference to the answer to Question D, this is a voluntary offer on the part of Mr. McKay. Sketches and descriptions should be sent to TELEPHONE ENGINEER and will be forwarded to Mr. McKay for his inspection and award of the prize.)

CO-OPERATIVE SPIRIT IN SAFETY WORK

Aside from such economic and humanitarian considerations as the conservation of man power and a reduction in the sum total of human misery attributable to accidents, safety work in industries is bringing a realization that the constant and sympathetic contact between employer and employe necessitated thereby is ushering in a new era in industrial relations, a fact which safety advocates are coming more and more to appreciate.

Organized safety in any industrial institution is brought to its full realization only through co-operative spirit from the executive head down through every department to the lowest laborer. This means that the manager must get in intimate touch with his foremen and in turn that they must sell their personal interest in safety to the workmen under them. This can be achieved only by contact and contact is a great leveler of traditional prejudices. Managers, foremen and workmen, meeting around the conference table for discussion of problems in which all have a vital personal interest, are certain to get new angles on the estimation of the other fellow.

We doubt not, that in many safety conferences held in industries, managers have been surprised to discover latent executive talent among their foremen and workers which can be turned to productive advantage, while workers who have rubbed shoulders with the manager have discovered to their surprise that the "boss" is entirely human and just as susceptible to sympathy and reason as any one of them. This inculcates a friendly spirit and finds reflection in mutual effort toward the goal of accident prevention and which is certain to make easier the solution of other industrial problems as they arise.

If accident prevention work did nothing else it merits reward of the highest character for having unconsciously broken down many of the prejudicial barriers which prevented the fullest exercise of that friendly intercourse essential to harmony in industry and for having established a movement in which employer and employe can meet as friends on common ground. It is not only a movement in conservation of life, and wealth, it is a harbinger of good will and sympathetic understanding and not until it reaches its full fruition will the vast extent of its influence be known.—Cincinnati Telephone Bulletin.

MORE ABOUT "POLING" RECEIVERS

Mr. O. E. Johnson of Seattle, Wash., sends the following suggestions:

In re Mr. Whitson's letter in the July issue.

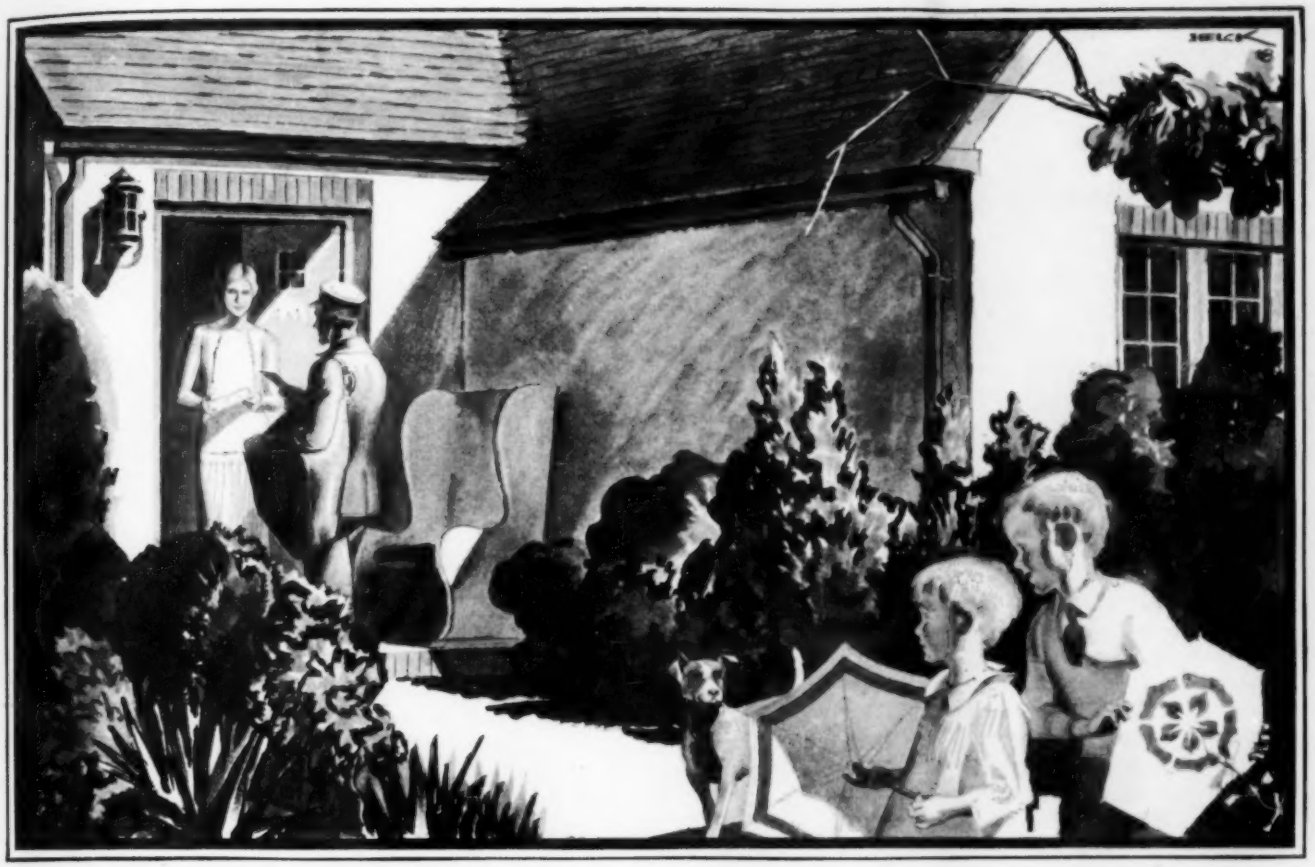
I use his way of getting the polarity, but go a little further.

I disconnect one line after testing for polarity, short the line terminals and make it howl.

If the phone is working right you get howls of two frequencies by reversing battery or receiver leads.

After making these two tests I have three ways of making the connections standard. I use the higher pitch howl so if my tests gave subtractive common battery and low pitch howl on local battery I would reverse receiver leads.

If I got subtractive common and high local I would reverse the line.



Where the Bell System's profit goes

An Advertisement of the
American Telephone and Telegraph Company

THERE is in effect but one profit paid by the Bell Telephone System. This profit is not large, for it is the policy of the Bell System to furnish a constantly improving telephone service at the least cost to the public.

The treasury of the American Telephone and Telegraph Company receives dividends from the stock of the operating companies. It receives a payment from the operating companies for research, engineering and staff work. It receives dividends from the Western Electric Company—makers of supplies for the Bell System—and income from long distance operations.

Only one profit is taken from this money in the American Telephone and Telegraph Company's treasury. That is the regular dividend to its stockholders—now more than 420,000 in number—which it has never missed paying since its incorporation in 1885.

Money beyond regular dividend requirements and a surplus for financial stability is used to give more and better telephone service to the public. This is fundamental in the policy of the company.

The Bell System accepts its responsibility to provide a nation-wide telephone service as a public trust.

For additive common and low local I reverse the battery leads.

I do not know for sure if the higher pitched howl is best.

It seems to me that it is due to increased pull on the diaphragm. You can change the pitch by reversing battery or receiver leads.

OUTPUT OF PRESERVED TIMBER DOUBLES IN FIVE YEARS

Evidence of the continuing upward trend of the wood-preserving industry in the United States is again presented, says *Wood Preserving News*, commenting on the statistical report compiled by R. K. Helphenstine, Jr., of the United States Forest Service, in cooperation with the American Wood-Preservers' Association, covering the year 1927, and just published. The number of treating plants in active operation was greater, the quantity of preservatives used was greater, and a larger amount of wood was subjected to treatment than was reported for any previous year.

The total volume of material treated in 1927 was 345,685,804 cu. ft., the equivalent of 4,148,229,648 bd. ft., an increase of 19½ per cent over the amount treated in 1926. This figure more than doubles the 166,620,347 cu. ft. treated in 1922.

Preservatives

In 1927, 219,778,430 gal. of creosote were used, an increase of 34,045,250 gal., or 18.3 per cent over the previous year. Of this total, 91,061,509 gal., or 41.4 per cent, were imported, more than half of which came from England, and the remainder from Germany, Belgium, Canada, Japan, Mexico, and Holland, listed in order of quantity imported. This shows a decrease in the percentage of imported creosote used in 1927, since in 1926, when considerably less creosote was used in this country, 51.4 per cent of it was imported.

Poles

The total number of poles of all species treated in 1927 was 3,637,989, an increase of 29 per cent over the 2,813,130 treated in 1926. Southern pine poles stood at the head of the list in point of number treated, with a total of 1,738,839, or nearly half the total quantity reported, given full-length pressure treatment. Western red cedar poles came next with a total of 1,112,500; northern white cedar, 431,744; chestnut 324,248; lodgepole pine, 19,149; Douglas fir, 507; miscellaneous species, 159, all of which were given butt treatment only. A total of 10,831 Douglas fir poles and 12 poles of miscellaneous species were also given full-length pressure treatment. Pressure-treated southern pine poles increased 87.8 per cent over the previous year, butt-treated cedar poles increased 3.2 per cent, and butt-treated chesnut poles decreased 3.2 per cent.

TABLE I
Wood Treated in 1926 and 1927

	1926	1927	Per Cent Increase
Crossties—No.	62,654,538	74,231,840	18.5
Bridge and miscellaneous timber—Bd. ft.	254,582,201	309,849,700	21.7
Switch ties—Bd. ft.	158,128,637	182,411,211	15.4
Poles—Southern pine—No.	925,929	1,738,839	87.8
Poles—Cedar, chestnut, Douglas fir, etc. (99.4% butt treated)—No.	1,887,201	1,899,150	0.6
Wood block flooring—Sq. ft.	10,822,518	13,853,817	28.0
Wood block paving—Sq. yd.	202,993	468,847	131.0
Piling—Lin. ft.	18,366 075	17,241,345	—6.1
Cross arms—No.	2,169,097	1,626,641	25.0

Radio Connection Established

Referring to the merger of the Mackay Companies with I. T. & T., this review says:

"It has been said that the new combine needed a radio company with world-wide connections to round out its system. It has been overlooked that through the merger with the Mackay Companies, I. T. & T. secured at least a close working arrangement with one of the largest and best established radio companies, the Kolster Radio Corporation.

"The company assumed its present title only in April, 1928, succeeding Federal-Brandes, which was incorporated two years before to acquire the capital stock of the Federal Telegraph Company and four other subsidiaries. Rudolph Spreckles, of San Francisco, is chairman of the board. The company manufactures and sells general commercial radio equipment and home radio receiving sets under the "Kolster" trade name. It may surprise many to whom the name is unfamiliar to learn that the company already has plants at Newark, N. J., Palo Alto, Calif., Toronto, Canada, and Slough, England, and is equipped to produce 2,000 sets a day.

Extensive Expansion Seen

"Last year the Federal Company sold its radio communication system on the West Coast to the Mackay group, under a twenty-year agreement whereby the latter contracted to purchase from the Federal Telegrah Company all radio, wired radio, telephone repeater, facsimile telegraphic and photographic transmission equipment required in its communication system on a cost plus 25 per cent basis. The Mackay system has already placed orders for five Pacific Coast stations to be completed this year, these now becoming part of the I. T. & T. system. Federal also has radio interests in China.

"Further, the company has a contract whereby the Columbia Phonograph Company, connected with Columbia Gramophone, Ltd., will use and market exclusively 'Kolster Radio' and 'Kolster Electric Phonograph.' This contact reaches not only to England and its colonies but through subsidiaries to Germany, Holland and other Continental countries.

It has been known for some time that I. T. & T. intends to branch out extensively in the radio field. The initial point of departure is expected to be in South America, which will be put into touch by wireless with Spain. North and South America are also expected to be linked together. Through its merger with the Mackay system I. T. & T. now operates the Federal Telegraph Company, operating on the Pacific Coast.

Empire Companies Build 30-Mile Telephone Line

Bartlesville, Okla.—The telephone and telegraph department of the Empire companies is constructing a 30-mile telephone pole line extending company service to the new compressor station of the Cities Service Gas company, an Empire subsidiary, which will be located near Corwin, Kansas.

This line will be a single metallic copper circuit, strung on brackets, and will be an extension to the present Ponca City-Pampa line constructed last fall and which had for its purpose of the establishing of telephone communication along the southern terminus of the Cities Service Gas company's 20-inch Pampa to Wichita natural gas line, which was also completed in 1927.

The poles used in this construction are principally 20-foot creosoted southern pine, 25-foot poles being used at road crossings. Twenty-five men, under the direct supervision of Foreman Glenn L. Johnson are engaged on this work and it is estimated that 1,089 poles and 2,160 brackets and insulators will be used.

New Exchange Building for Jasper, Ind.

The Southern Indiana Telephone & Telegraph company is planning a new exchange building for their Jasper properties. The building will be constructed of stone and brick, with two stories and basement.

Pep *and* Power

..for better telephone service

YOU want "pep" in a telephone battery for good transmission. And you need sustained power for a satisfactory service life. Telephone men throughout the country know that they find the winning combination of Power and Pep in French Ray-O-Vacs. Exhaustive tests have proved French Ray-O-Vacs' greater "come-back" power—their greater rapidity in rebuilding their strength when the receiver is back on the hook. Tests, too, have proved their pep—showing French Ray-O-Vacs delivering their high original voltage longer than any other battery. Why not get this longer life, lower service cost and greater economy? Just specify French Ray-O-Vacs the next time you buy batteries.

FRENCH RAY-O-VAC

TELEPHONE CELL

FRENCH BATTERY COMPANY

Factory: Madison, Wis.—*Sales Office:* 30 North Michigan Avenue, Chicago, Ill.

Branches: Minneapolis, Cleveland, Denver, Philadelphia, Atlanta, Detroit, Kansas City, Boston, New York, Pittsburgh, Los Angeles

Also makers of **Ray-O-Vac Radio Batteries, Ray-O-Vac Ignition Batteries, Ray-O-Vac Flashlights and Flashlight Batteries.**

Automatic Telephone Service for Athens, Ohio

1200 Lines of Strowger Automatic Telephone Equipment Housed in New Telephone Building Placed at Disposal of the Public at Midnight, Saturday, August 18th.

Promptly at midnight on Saturday, August 18th, Dr. C. L. Jones, secretary and manager of the Home Telephone Company, Athens, Ohio, placed the first official call over the automatic telephone to Mayor C. L. Moore. Following this successful first conversation, a second call was made by Mr. W. E. Moler, treasurer of the Home Telephone Company, to the Elks Club. The fire and police departments were then called to make sure that these lines were all clear, after which many of those in attendance at the cutover ceremonies dialed their friends to inform them that Athens' new automatic telephone system was in operation. Present on the occasion were the officers and directors of the Home Telephone Company, including A. F. Homes, president; W. N. Alderman, vice-president; W. E. Moler, treasurer; C. L. Jones, secretary-treasurer; H. S. Burson, cashier and F. R. Eckley, commercial engineer. Besides these, there were present Mr. Fulkerson and Mr. S. C. Alsdorf, of the Newark Telephone Company, Newark, Ohio, and Messrs. C. L. Sosey, S. L. Smith, Warren Hess, S. M. Skinner, and Miss H. L. Reilly of the Ohio Bell Telephone Company and Mr. John Love, consulting engineer. Automatic Electric Inc., which company manufactured and installed the automatic equipment, was represented by Messrs. H. P. Mahoney, T. F. Crocker, G. Sorber, L. L. Ruggles, R. T. Dailey, C. S. Caldwell and E. R. Girard. Mr. A. R. Hailey was in charge of the installation work, which was excellent throughout. The subsequent issue of the Athens "Sunday Messenger" carried a very complete and interesting account of the cutover and history of the local telephone company up to the present time.

New Telephone Exchange Building of the Athens Home Telephone Company, Opened August 18th

The history of the Home Telephone Company has been one particularly rich in local color. The first telephone station to be placed in operation in Athens was in the dental office of Dr. C. L. Jones. Dr. Jones became interested in the future possibilities of the then new invention, and has been strongly identified with the progress of the telephone development in Athens from that day, now holding the position of secretary and manager of the local company. The new $150,000 modern telephone plant marks a milestone in the progress of the Home Telephone Company, and is a fitting climax to the years of effort of Dr. Jones and his associates to bring to Athens the very best and most modern in the way of telephone service.

The appearance of the new telephone building is imposing and stately, with its tall columns and straight lines. The style throughout, both exterior and interior of the building is what is known among architects as Roman Doric. The front entrance enters directly into lobby and business offices, which are trimmed with marble, with columns carrying out the same general effect as is followed in the front of the building. The floor is covered with rubber tile, and a classical stair case leads to the second floor. Two telephone booths, toll and special switchboards and the chief operator's office also occupy part of the first floor space, with the offices of manager and treasurer situated farther back. The extreme rear of the first floor is fitted up as a garage for the company's cars, opening into the alley in back of the building.

The basement has a large storage capacity, with a cable room where the underground cables are brought in from the outside, and a special ventilated battery room for the storage battery. Boiler and coal rooms, with an electric hydraulic elevator for transferring material from the rear alley to the basement are also provided. Constructed of terra cotta, glazed brick and steel, the building is absolutely fireproof in every respect.

The front part of the second floor has been finished off for two apartments, one five-room and the other four-room. It is expected that one of these apartments will be occupied by the wire chief, and the other by the chief operator, so that trouble complaints and special service calls will always have immediate attention, day or night. The remainder of the second floor is occupied by the automatic equipment, with ample room for expansion to take care of future growth in the telephone requirements of the city.

There are at present 1200 lines of au-

Four for Two is the HAYES Rate for You!

$4.00 FOR TWO No Higher

HAYES HOTEL NORTH

420 Diversey Parkway
at Lincoln Park
CHICAGO

OPPOSITE the famous Lincoln Park where you may enjoy golf, bathing, boating, tennis, riding and many other sports--only 12 minutes to "loop"--all north bound busses pass our door.

Every room with bath

Rates
Single —$2.50 to $3.00
Double—$3.50 to $4.00
NO HIGHER

Attractive Weekly Rates

Also operating
HAYES HOTEL SOUTH
64th at University Ave.

John Hayes Frank Hayes

Write for booklet

A Prest-O-Lite Torch is always "stripped for action"

YOU can get right to work with a Prest-O-Lite Blow-torch. It is always ready for immediate use. No time is lost in preparation. Turn on the gas, light the torch, and the job is under way.

There is a Prest-O-Lite Torch for every soldering or heating purpose. Telephone and electric light companies everywhere use Prest-O-Lite equipment for lineman's work and in the shop as well. Most of the largest companies have standardized on Prest-O-Lite.

Ask the Prest-O-Lite Gas distributor about this equipment or write us direct for complete information.

THE PREST-O-LITE COMPANY, Inc.
New York Indianapolis San Francisco
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Unit of Union Carbide and Carbon Corp.

Prest-O-Lite GAS

matic equipment which care for 2815 telephones. The primary line switches are of the plunger type, and are mounted 200 on a board. The connectors are mounted on separate boards. Toll train equipment and special switches, such as reverting call, test distributors, etc., are mounted on a special board.

The ringing current is furnished in frequencies of 16, 25, 33, 50 and 66 cycles by duplicate ringing machines. One of these operates from the commercial current, while the other operates from the storage battery in case of falure of the power supply. Interrupter attachments are provided on these machines for furnishing the dial and busy tones.

There is one charging set which operates from the commercial current of 220 volts, 60 cycle, three phase. This machine is designed to operate on a full float basis, which maintains the batteries in a fully charged condition at practically all times. Both charging and ringing sets are mounted on specially constructed bases of pressed brick, pointed with cement.

The control and supervisory equipment is mounted on the power board, which is conveniently situated in respect to the ringing and charging sets. The test desk is also located in the rear part of the equipment room, and is situated so that the test clerk has ready access to the power board and power equipment as well as to the automatic apparatus. This board, as well as the six position toll, rural and special service board on the first floor, was manufactured and installed by Automatic Electric Inc. of Chicago, Illinois.

With the completion of its conversion to automatic telephone operation, Athens now takes its place with the many other progressive cities of Ohio, which have a completely modernized telephone plant. Other Ohio cities using Strowger Automatic equipment include Columbus, Toledo, Youngstown, Canton, Lorain, Marion, Newark, Alliance, Bucyrus, Elyria, Massillon, Van Wert, Amherst, Delaware, New Philadelphia, Dover, Kenton, St. Marys, Granville, Green Camp, Malvern, Mason, Morral, and Waldo. Ohio may be said to be one of the most advanced states in this respect, as is shown by this impressive list of cities where the dial on the telephone stands as a symbol of progressive civic spirit.

Extensive Improvement Program of The Home Tel. & Tel. Co. of Fort Wayne

The purchase of the telephone properties of the Noble County Telephone company, embracing the Albion and Kimmel exchanges, by the Home Telephone and Telegraph company of Fort Wayne was announced August 1st by telephone officials.

With the addition of the Noble county company 800 stations will be added to the Home Telephone system and the exchanges will total eight, including Churubusco, Harlan, New Haven, Huntertown, Roanoke, Leo, Kimmel and Albion. Albion is the county seat of Noble county and has direct toll connections with Fort Wayne and Kendallville over copper circuits owned by the Home Telephone and Telegraph company.

A new cable plant and a new main frame at the central office of the Harlan exchange of The Home Telephone and Telegraph Company will be cut into service this week, it was announced August 27 by Harry E. Gray, general plant superintendent.

The cut-over this week will represent the completion of an extensive program of rehabilitation instituted by The Home Telephone and Telegraph Company shortly after it took over the Harlan plant.

All grounded circuits in the Harlan exchange have been made metallic, deteriorated wire circuits have been replaced with new wire and the aerial open wire has been replaced by aerial cable.

The Harlan plant can now serve the telephone users in a highly efficient manner, Mr. Gray stated.

The work of engineering for necessary rehabilitation at the Roanoke exchange is practically completed, and actual reconstruction soon will be started.

Deteriorated iron wire and cable is to be replaced and other work will be done to bring the plant up to its highest efficiency, Mr. Gray stated.

The operating quarters at the Roanoke exchange already have been enlarged, and a new main frame on which the outside lines are connected has been installed.

Work of rehabilitation at the Churubusco exchange of The Home Telephone and Telegraph Company is practically completed, it was announced by Harry E. Gray. All grounded lines have been made metallic, deteriorated wires have been replaced, new poles have been set, Mr. Gray stated.

Work of replacing poles and wire at the Leo and Huntertown exchanges has been completed. Both plants are now in condition to give a high grade of service, Mr. Gray stated.

Automatic equipment for installation in the New Haven exchange of The Home Telephone and Telegraph Company is being shipped on August 30.

According to Mr. Gray, installation of the equipment is expected to be completed before December 1. The equipment to be installed is practically the same as that in use in Fort Wayne. Its installation will require a regrouping of lines in the exchange with only ten subscribers on any one rural line.

Open wire in the town will be replaced with aerial cable and a number of circuits in the rural district will be changed from iron to copper. All the telephones now in use will be replaced with dial instruments.

Telephone Company Moves to Watonga

Watonga, Aug.—The United Telephone company, having lines throughout the county, has moved its main office here from Yale, and has plans for an extensive rebuilding and remodeling program Local buildings and lines at Geary, Okeene, Custer City, Thomas, Greenfield and the Watonga lines are being rebuilt, an entirely new toll line has been installed between Watonga and Geary and plans are made for building a group of residences to care for employes.

New Lines to Be Built to Lima

Construction of two new long distance circuits to Lima is to be started in a few days by the Ada Telephone Exchange company, it was announced recently by George B. Quatman, general manager of the telephone department of the Suburban Power company. He is making his headquarters here for the present and is assisting John Lantz, manager of the local telephone company in planning the new program to be carried out as the result of the purchase of a controlling interest by the Suburban Power company.

The new circuits to Lima are the first of a number to be constructed to surrounding cities, planned to give almost instantaneous service on long distance calls to these points. Local telephone owners will soon be able to get a station in Lima without hanging up the receiver after placing the call, says Mr. Quatman.

A carload of wire and other equipment arrived here this week to be used in construction of the two new Lima circuits, and a new post hole digger, a recent invention.

John Lantz will continue as local manager of the company, and no changes are contemplated in the operating personnel, it is announced. Specialists will be brought here from other telephone properties of the company when needed to assist in extending the system and improving the service.

Is Time a Day Worth a Nickel?

Some of the larger telephone companies in the east are again giving patrons the time of day on demand—at local toll rate. The service is not compulsory, you can take it or leave it.

AMERICAN CROSSARM & CONDUIT CO. Manufacturers and Distributors
14 Mills Main Office—Chicago, Ill. 38 Warehouses
CROSSARMS — FIR — Creosoted — Yellow Pine
Creosoted Wood Conduit
Pin and Brackets

Super-Service on rush orders!

If you are in a hurry your order can be loaded and on the way the same day we receive it.
Quality poles since 1882 assures you of guaranteed stock and satisfactory dealings. Let us quote you prices.
Northern and Western Cedar
With or without butt treatment
NAUGLE POLE & TIE COMPANY
59 East Madison Street, Chicago
Branches: New York, Columbus, Kansas City, Spokane Vancouver, Boston Yards: *Minneapolis, *Pinconning, Mich.; *Spokane, *Sand Point, Ida.; Vancouver, B. C.
*Butt-treatment plants and Pentrex incising machines.

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HUBBARD
GUY CLAMPS
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GUY HOOKS
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GUY WIRE PROTECT-ORS
WRITE FOR COMPLETE CATALOG
HUBBARD AND COMPANY
PITTSBURGH
OAKLAND
CHICAGO

Bell Cedar Poles
Piling & Ties
Western Red - Northern White
Creosote Butt Treating—Any Specification
Guaranteed N. E. L. A., W. R. C. A., N. W. C. A. Grades
Treating Plants and Concentrating Yards
Minnesota Transfer, Minn., Newport, Wash.
Other Concentrating Yards at British Columbia Points
There Are No Better Poles Than Those Produced by
BELL LUMBER COMPANY
Security Building Minneapolis, Minn.
Long Distance Phone Atlantic 2304

Cedar Poles
Northern White Western Red
Plain or Treated Butts
Prompt Shipment from Minneapolis Yard.
T. M. Partridge Lumber Co.
Minneapolis, Minn.

USE PATENT ANCHORS MORE CHANCE
CHANCE MAKE BETTER ANCHORS POLE LINES
A Type and Size To Meet Every Need
Specify CHANCE ANCHORS Your Jobber Will Supply you

CHANCE CO.
CENTRALIA, MO.

INSURE YOUR OVERHEAD LINES BY SPECIFYING
NORTHERN or WESTERN
CEDAR POLES
PLAIN or BUTT-TREATED
FROM
MacGillis & Gibbs Co.
120 E. Wisconsin Avenue,
Milwaukee, Wisconsin

REPUBLIC POLES
Northern and Western Cedar
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REPUBLIC CEDAR CO., Marinette, Wisconsin

Single Interlocking and Multiple Crosoted Wood Conduit
ZINC CHLORIDE TREATED LUMBER
W. C. MEREDITH CO. Atlanta, Ga.

Mid-Summer Tri-State Convention Enthusiastic

Last year it was John Wright's convention at Jamestown. This year it was the Mutual Telephone company's convention at Erie. And Erie did herself proud in the way she handled the sessions and the entertainment features.

* * *

And the convention got away to a good start right from the beginning. It was New York Day, and New York is not slow about anything. J. G. Ihmsen of Albany, president of the Up-State Telephone convention, acted as chairman.

* * *

President A. A. Culbertson of the Mutual Telephone company of Erie, was called upon and on behalf of his company and its employes he welcomed the visitors to his home town, and explained that he had been planning the arrangements for some time and hoped the guests would be pleased with the reception. At the close of the three-day meeting it was unanimously decided that Mr. Culbertson builded better than he knew.

* * *

On the program for New York Day were John P. Boylan of Rochester, general manager of the Rochester Telephone Corporation; E. B. Russell, general traffic manager of the New York Telephone Co., Albany; Ray H. Manson, chief engineer, Stromberg-Carlson Telephone Manufacturing company, Rochester; Stanley R. Edwards, editor of Telephony, Chicago; and Howard K. Jones of the firm of Aldon, Howard & Jones, architects, Pittsburgh, Pa. Sergius P. Grace, assistant vice-president Bell Telephone Laboratories, New York City, was introduced as an added attraction, and mentioned some of the new discoveries of recent months.

* * *

And New York Day seemed about to carry off the honors for it was indeed a great day—a wonderful program and well proportioned, covering many phases of the business in a masterful way. But just wait! Pennsylvania is to have its inning.

* * *

H. E. Bradley, of Harrisburg, Pa., presided for the Pennsylvanians. Who ever heard of a Pennsylvania meeting without Brad? Some outsiders were slipped in on the program; not because Pennsylvania lacked for material or oratorical ability, but simply because other "big guns" were there and had to be shot (not half-shot). On the program for Pennsylvania were Roy F. Wilder, general commercial manager of the Tri-State Telephone & Telegraph company, St. Paul, Minn.; H. R. Clegg, division plant manager, Bell Telephone company of Pennsylvania, Pittsburgh, batted for F. J. Chesterman of the same company, the latter being unable to attend; Charles H. English, an attorney, Erie; Harry G. Baldwin, Milwaukee, Wis.; and R. F. De Voe, president of R. F. DeVoe & Co., New York City.

* * *

And then came along Ohio Day! And man alive! The way oratory fell from the lips of those on the program for Ohio Day was a caution. And wisdom in every sentence. Frank L. McKinney, secretary of the Ohio Independent Telephone Association presided, and the ease with which he goes about the job gives assurance that the program will be a polished affair as far as the chairman is concerned. First on the program was J. Warren Safford, president of the Ohio Independent Telephone Association, and his subject was "Just Minding Our Business"; he was followed by J. F. Carroll of Cleveland, general manager, Ohio Bell Telephone company; following next was D. E. Lowell, Philadelphia, engineer of foreign wire relations of the Bell Telephone company of Pennsylvania; and the concluding number was W. S. Vivian of Chicago, director of public relations of the Middle West Utilities company.

* * *

If there had been a contest between the three states as to which would put on the best program the writer would still be in doubt as to which would have won the prize. Every day was great.

* * *

We would like to give a synopsis of the addresses made at this convention. There was so much good material. But in our limited space we must pass this up and will probably give space to some of the papers read in a future issue.

* * *

Traffic conferences were well attended the last two days of the convention. These were presided over by H. F. Gingenbach of Erie, superintendent of traffic of the Mutual Telephone company. Those on the program were Miss Mary McMurtry, Buffalo; Miss Myrtle Anderson of Oil City, Pa.; Miss Mildred Bates, Pittsburgh, Pa.; Mrs. Mary Post, Erie; Mabel Pearson Sellvin, Jamestown, N. Y.; E. E. Michael, Cleveland; Dr. Ford Eastman, Erie; and Mrs. Blanche Nelson Dolan, Pittsburgh, Pa.

Oh, You Picnic!

Was the fish fry popular? We'll say it was! Above (center) is shown Mrs. Lloyd Wright of Jamestown, N. Y., enjoying her "fish and—" at Presque Isle Peninsular, when some five hundred employes enjoyed the old-fashioned fish fry and barbecue. Mrs. Wright is the wife of Lloyd Wright, vice-president and manager of the Jamestown Telephone Corporation, but is just "one of the girls" when picnicing.

* * *

The old-fashioned fish fry and picnic on the Presque Isle Peninsular was one long to be remembered. Contests were arranged by the Mutual Telephone company of Erie and many prizes were offered. Groups entered into the contests with spirit, dignity being cast to the winds. Bathing was indulged during the entire afternoon of the second day, at the end of which the fish fry was enjoyed by several hundred visitors.

* * *

The annual banquet and dance closed the third day of the convention. About 400 attended the banquet and enjoyed the evening in the ballroom.

* * *

Golf tournaments were indulged in each day by the golf enthusiasts and prizes were awarded at the close of the convention.

* * *

At the concluding session the Mutual Telephone company of Erie was remembered in a resolution offered by H. E.

Do you buy just poles or years of SERVICE?

AFTER all, long service at low annual cost is what you expect of a pole. Faithful duty through the years. Withstanding storms. Holding proudly erect under heavy ice loads. Maintaining uninterrupted line service. Holding good will.

Prettyman Preserved Poles will fulfill these expectations for 25 to 40 years and more.

Strong with the static bending strength of Southern Yellow Pine (44 per cent higher than that of the next strongest pole wood) they are virtually immune to decay. Uniform, full-length impregnation to the heartwood with hot Grade 1 creosote oil effectively shields them from the ravages of termites (white ants), fungi, woodpeckers and the deleterious effects of certain soils.

Careful selection in the *Prettyman* forest, expert handling through every phase of production under rigid inspection and jealous protection from infection or fibre strain assure you a pole in which the full natural strength of the wood will be unimpaired throughout the multiplied years of its life.

They are available at low cost in any quantity on short notice. Shipping facilities include deep water docks for accommodation of ocean-going vessels and direct connections with three important trunk lines. Write *now* for quotations.

PRETTYMAN PRESERVED P28 FOREST PRODUCTS

J. F. Prettyman & Sons
Wood Preserving Plant
Charleston, S. C.

Bradley and unanimously adopted, for the very excellent manner in which the guests were treated.

* * *

Frank L. McKinney of Columbus, Ohio, secretary of the Ohio Independent Telephone Association, stated that the convention next year would be held somewhere in Ohio, the place and date to be announced later.

* * *

During the Play Hour

Where dignity was forgotten. Presidents, superintendents, managers, linemen and other employes indulge in a game of "tug of war" during the play hour at the Tri-State convention at Erie. This shows where Ohio is tugging at one end of the rope and Pennsylvania at the other.

Excuse Us, Please!

Last month the editor undertook to give the genesis of a Texas pine sapling that graced the sandy lands of that state. The story was told all right, but as happens with many Southern writers, there was something wrong with the head—its head, we might say. For over this story telling of the life and death of this beautiful, graceful, strong young pine tree, from its birth to the time it was placed in service on a stretch of telephone lines in Kansas, we put this inscription: "The Autobiography of a Black Cedar Pole." Wasn't that enough to make any pole turn black, let alone a fine young pine, which has the strength of giant trees of other names!

What we want to say is, that the story was all right except the head, which was all wet. "The Autobiography of a Black Beauty Pole" is the story of a very interesting booklet issued by the Texas Creosoting Company, and can be had by addressing them at Orange, Texas. You will enjoy reading the booklet and will be well repaid for your time in the knowledge you secure.

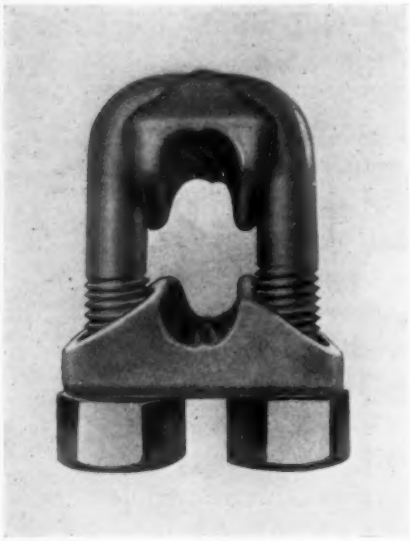
New Cable Clip Having Two Fully Grooved Jaws

A cable clip with a considerably larger holding surface has been put into production, in a full range of sizes, by the Eureka Metal Products Corporation of North East, Pa.

The following claims are made for this cable clip:

It is a patented clip which, according to tests, has shown its ability to carry three times the maximum load of an ordinary clip—and gives equally good results both on wire rope and messenger strand.

Besides giving a larger holding surface, the Eureka clip saves cable—there is no distortion of cable whatever. The large surfaces of both the top and bottom plates are grooved for the lay of the cable, so that neither of the cables is gripped by the U-bolt.



Triple Grip Gives Triple Safety

The construction of this clip is extremely rugged, and it has only four parts, just the same as the ordinary type of cable clip. The Eureka clip's extra grooved jaw is peened to the "U."

An examination of the Eureka clip makes it easy to understand why users of cable are showing a special interest in the extra margin of safety provided by this improved clip.

The Eureka clip, according to the manufacturers, gives triple safety because of its triple grip upon the cable. This is perhaps the most important feature from the standpoint of most users, especially structural erectors, with whom "safety first" is always a prime consideration.

But another feature that users have found almost equally important is the fact that any size wrench can be used to tighten up the Eureka clip. There is no chance whatever of injury to the cable, regardless of the size wrench that is used—no restriction on the length of wrench handle is necessary. This clip's double grooved surface prevents any distortion of the cable, no matter how tight the nuts are pulled down.

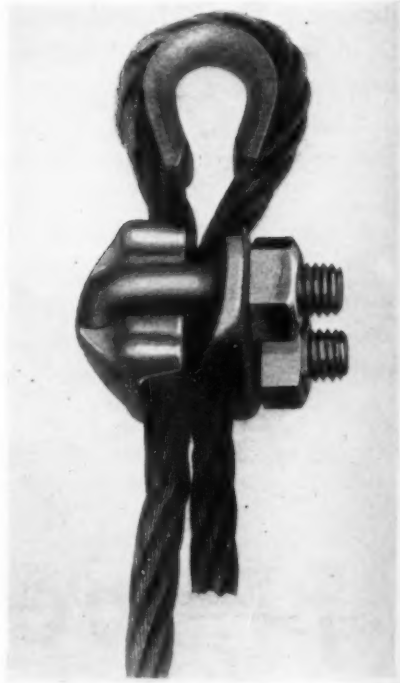
And there is no restriction on the way in which these clips are placed on the cable—it doesn't matter which way the U-bolt is turned. The clips can be staggered on the cable, or placed with the U-bolts all the same direction, and it makes no difference. There are no "circle bends" in the cable from the clips, and the U can be placed over the live cable with just as good results as when turned the other way.

The double grooved surface forms a perfect loop—perfectly symmetrical, with equal flexibility on both sides. The stresses on the cable are equalized under heavy loads.

Savings reported, through use of the Eureka patented clip, include a very considerable saving in cable because there is no cutting of the strands by U-bolts. The scored surfaces cannot injure the cable, no matter how tight the clip is pulled up.

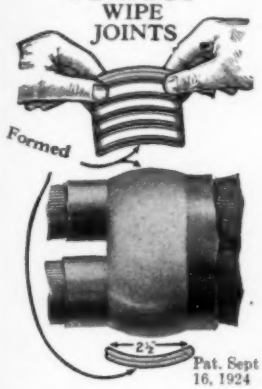
There is also a direct saving in clip cost, and a very considerable saving in labor, because fewer clips are needed, it is claimed.

These patented clips are made in all sizes, of steel or bronze, and are sold by the manufacturer with an absolute guarantee of satisfaction to the user. Small trial orders are accepted, and a descriptive folder can be obtained by writing the Eureka Metal Products Corporation, North East, Pennsylvania.



Simple and Sturdy Design, with Only Four Parts

PERFECT WIPE JOINTS



Pat. Sept 16, 1924

FORMED—flexible—finished wiping cloths for CABLE-SPLICERS insure uniform durable wiped joints on cable sleeves. Ready for use. Need no breaking in.

Let me tell you why it is cheaper to furnish your cablemen with these cloths than to allow them to use the old style shapeless, unfinished cloths.

WRITE FOR LITERATURE

GEO. E. WILLIAMS

3 East 26th St. Minneapolis, Minn.

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STANDARD TELEPHONE WIRES AND CABLES

BARE COPPER WIRE
COPPER CLAD WIRE
RUBBER INSULATED WIRE
GLAZED BRAIDED WIRE
FLAMEPROOF BRAIDED WIRE
WEATHERPROOF WIRE
LEAD COVERED CABLES
ARMORED CABLES
CABLE ACCESSORIES

Standardize on STANDARD

The greatest economy results when manufacturing responsibility for telephone conductors is undivided. When the wires, cables and cable accessories are all STANDARD products, responsibility for satisfactory service rests entirely with us. *Use our complete* STANDARD *line!*

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Order Furnaces and Torches NOW For Winter Use!

Get them early so you will have them on hand for the fall and winter. *Insist* on the "ALWAYS RELIABLE" for perfect satisfaction and durable service. They have a *good long-standing reputation*, and are *fully guaranteed.*

Order thru your regular distributor, or mail your order to us with the name of your regular distributor.

No. 22. Gasoline furnace with large top plate and 9¾" shield. COVERED BY PATENTS

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With an Exide battery on the job, a long life of dependable, trouble-free service is assured. That is why Exides are so generally used by the telephone systems throughout the country.

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TAKE the case of a typical electrical organization. It must buy all the equipment for a pole line by 2 P. M. today. A handful of special pliers by 10 A. M. tomorrow. A complete motor installation by 5 P. M. tomorrow. What problems beset a purchasing staff!

But how easily those problems clear up with the help of that great market basket provided by Graybar's nationwide distributing system. Cross-arms and pliers, conduit and motors, clothes washers and wire—these and 60,000 other items are at your service at a convenient Graybar distributing house nearby, all marketed and ready.

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Successor to *Western Electric* Supply Dept.

Offices in 70 Principal Cities

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Ramblings

By J. A. S.

The Methodist organization lost one of its best chances of the century for a national evangelist when W. S. Vivian decided to enter the telephone field instead of the ministry. Those who have heard him agree that his earnestness, enthusiasm and evangelical emotions would sway thousands if used in that direction. His address at Erie endeared him to many telephone people who have entered the telephone field since Vivian took up other work.

* * *

Yes, we enjoyed every minute of the time we spent in Erie. It is a wonderful city in a wonderful section of the country. And its hospitality is incomparable. Those who control the destinies of the Mutual Telephone Company of that city comprise the last word in courtesy. And this was the basis underlying the success of the Tri-States Telephone convention which met in Erie August 8, 9 and 10.

* * *

While talking about Erie, we cannot refrain from stopping here to express our regret that John Z. Miller was not among those of the Mutual Telephone Company to greet us. Miller has been with that organization so long that it is hard to think of one without the other. He is an able telephone executive and we doubt not that he will be picked off by some enterprising company before many moons.

* * *

And just across the lake from Erie, some three hours' ride, are many joy shops. We're not intimating that any telephone man crossed the lake or visited the joy shops on the Canadian side, or associated with "blind pigs" in Erie. For they are the salt of the earth. But we merely mentioned this in passing. 'Tis said that you must have a permit in Canada before indulging in the luxury of suds or stronger liquids, but it was our experience in Niagara that business was too rushing to bother with government permits.

* * *

"Pop" Wilson, formerly general manager of the Mutual Telephone Company, but now retired from business, was very much in evidence during the recreation and sports program of the Erie meeting, and one would have thought that he would be the last man at the convention to retire. It is said that he spent the summer in New Jersey.

* * *

L. W. Scherer, general manager of the United Telephone Corporation, operating down in Oklahoma, has moved his office to Watonga from Yale, Okla., former general offices. Scherer is president of the Oklahoma Utilities Association, and until his removal to Watonga was a leader in most of civic organizations of his home town. He will doubtless head some of the similar organizations in Watonga, for Scherer is built that way.

* * *

Roy Franklin Smith drove up from Fort Worth during August to visit his father, J. A. Smith, manager of TELEPHONE ENGINEER. Roy reports roads through the states of Oklahoma, Missouri and other points covered in fair condition; he made the trip in some thirty hours' driving time. He spent about ten days in Chicago.

* * *

A. H. McConnell has resigned his position as secretary of the Idaho Public Utilities Commission to connect himself with the Interstate Utilities Company of Spokane, Wash. McConnell has been with the commission for four years, but has decided that the life of a public utility servant is preferable to that of the professional politician.

* * *

Frank E. Bohn, president and general manager of the Home Telephone & Telegraph Company of Fort Wayne, Ind., spent a very pleasant vacation rusticating around Yellowstone National Park and in Wyoming. He was accompanied by his wife and daughter, which accounts for his safe return to his job. Bohn is one of the most far-seeing telephone men in the industry.

* * *

The Hotel La Salle, Chicago, is slated for the scrap heap, reports state. It is to be replaced by another banking house. The old La Salle is one of the few hotels in Chicago where National telephone conventions have been held. From 1913 to 1917 it was the annual meeting place of the Independents in national conventions. It witnessed the split and the welding of national bodies; the La Salle was the "elite" of former telephone days. Possibly telephone financing of promoting concerns is responsible for its demise. Who knows?

* * *

Lon J. Jester, of Carbondale, Ill., who has been district manager of the Illinois Southern Telephone Company, more recently the Illinois Commercial Telephone Company, has been made general manager of the Mid-Continent Telephone Company, with headquarters at Chicago. This concern has exchanges in several states. Mr. Jester has been active in telephone work for a number of years.

* * *

Frank A. Knapp, general manager of the Northern Telephone Company, returned during August from a seven weeks' trip through Europe, visiting England, France, Germany, Switzerland and Belgium. He was accompanied on the trip by Mrs. Knapp, and the trip was enjoyed by both to its fullest, as no business was transacted during the time. Mr. Knapp did not make an attempt to study telephone conditions while abroad, but did make a few observations, which we hope to present our readers in the near future.

* * *

Fred J. Heavens, for many years with the P. & A. Telephone Company at Pittsburgh, but for the past few years representing the Kellogg Switchboard & Supply Company in South America, is back in the good old U. S. A., and making his home with the missus over at Elyria, one of the beauty spots of Ohio. Mr. Heavens gave up his work with the Kellogg company on account of bad health, and we trust that he not only regains his lost health, but that he finds fortune in his present occupation, which will be announced in the near future.

* * *

Winston Rodormer spent a few weeks in Colorado this summer. Winston is a son of Geo. W. Rodormer of the Reliable Electric Company, and like his hard working dad, began work last spring as though everything rested on his shoulders with the result that he was unable to weather the heat during July and August.

Empire Oil Firm Builds Phone Line

Cherokee, Okla.—A branch telephone line is being constructed through Alfalfa county by the Empire Oil and Gas Company. The line is more than thirty miles in length and will connect the company's proposed booster pump station to be located at Corwin, Kansas, with the main offices at Bartlesville. The line is a part of the control system being built in conjunction with the gas line which the Empire company is laying from its fields near Pampa, Texas, to Kansas City.

New Guaranteed

¼ h. p., A. C., 110v., 60-cycle, 1-phase, double shaft

MOTORS

complete with emery and buffing wheels

$15.00

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Used Drop Wire
$25.00 Per Ton

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The "STEWART" Cable Tester

Locates shorts, crosses, grounds and wet spots to an inch. Will often save its cost on one case of cable trouble.

Order a "STEWART" Cable Tester and be sure you are going to locate your next case of cable trouble quickly.

Any telephone man can use it. Not an instrument that only an expert can use.

Equipped with two vibrators and an indicating lamp. Write for circular.

Sent on 10 days' trial.

Also, Test Sets, Test Cabinets and Detecto-Meters.

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"REBUILT" TELEPHONE APPARATUS and exchange equipment saves you 30 to 50 per cent without sacrificing quality or efficiency.
SWITCHBOARDS—Telephones—Apparatus—Protection Equipment—Cable—Everything you need for the installation and operation of a complete exchange—Magneto or Central Energy—of the best and most reputable manufacturers.
Fourteen years' successful operation of our rebuilt equipment department puts it past the experimental stage. Quality and price will make you a permanent customer. Better investigate.
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"Know where you stand"

Investigate Our Centralized Accounting Plan

This monthly Audit will save you lots of money and give you important information that you should have about your business—the best of all business, if properly managed.

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Get EVER-PROTECT aid in your construction.

EVER-PROTECT has proved practical and profitable in making many hundreds of cable installations underground without a conduit. It protects cable against storm damage, corrosion, chemical action, electrolysis and abrasion.

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Ask your nearest jobber for complete details.

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OUR position enables us to offer well managed companies, permanent financing at attractive rates. We advise you to consult us and obtain definite terms before closing any new financing. There is no cost or obligation in having a member of our organization visit your plant to confer with you.

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CONVENIENT TRANSPORTATION to EVERYWHERE
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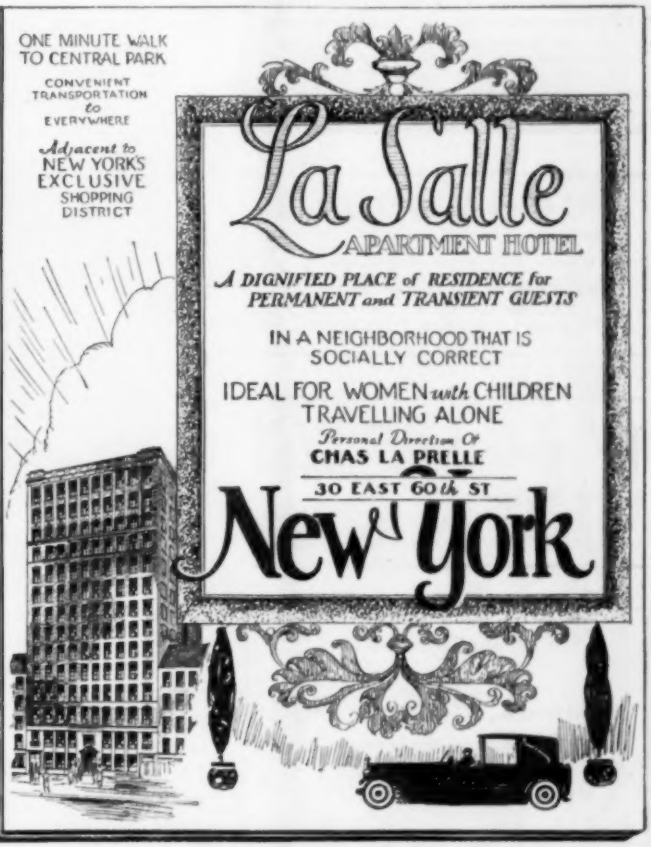
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Specialization on Public Utility Accounting Records and Audits enables us to best serve Telephone Companies.

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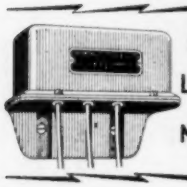

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COLUMBUS, O.

Make Use of Our Combined Century of Engineering Experience

The Highway Earth Boring Machine and Pole Setter

A most effective earth boring machine and pole setter on the market is offered in a combination which will revolutionize line construction and maintenance work. Owing to the fact that it will traverse and operate in thick underbrush where it would be impossible for man to go on foot, no skids being required. It operates in ditches, knolls, hollows, embankments, reaches and digs, as well as sets the pole, in any kind of soil and all kinds of weather. In addition to digging straight holes it will dig at any angle which is a time saver in digging anchor holes suitable for all types of anchors.

An average of a pole in the ground every five and one-half minutes is the record recently established by the Highway Earth Boring Machine and Pole Setter in actual line construction work.

The feasibility of setting the pole at the time hole is dug, also the possibility of dragging the pole to a position so it can be hoisted in position is possible by using the cable supplied from the winch which is controlled from the driver's seat. The winch is driven from a power take-off, which is sturdy in construction, and is fully capable of taking full engine torque.

The pole derrick is seventeen feet in length, made of 3½ in. diameter 40-carbon seamless steel tubing, and the pole derrick is capable of setting poles 45 ft. in length.

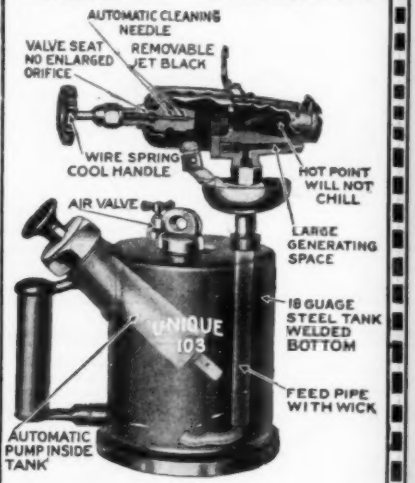
The Highway Earth Boring Machine is largely used with a 20-in. auger, but is capable of handling augers from 8 ins. to 24 ins., the latter under favorable conditions. Dirt piles at edge of hole convenient for re-filling.

The labor and time saved in line construction pays many times its first cost.

More detailed information regarding this machine may be obtained by plant maintenance and construction men, or others who may be interested by writing the manufacturer, the Highway Trailer Company, Edgerton, Wisconsin.

UNIQUE

BLOW TORCH



It starts quickly, operates in any position, and produces a remarkable heat. It is a great worker in cold and windy weather.

The automatic orifice cleaner, one of the details shown in the illustration, is but one of a number of exclusive features that make the Unique your greatest value in blow torches.

Painstaking care by interested workmen, an actual "burning test" before shipping, is just another detail responsible for their uniformity and efficient burning qualities.

Write for complete details

Unique Manufacturing Co.

221 Whiting St. CHICAGO, ILL.

When Writing Advertisers Speak a Good Word for TELEPHONE ENGINEER

OPERATORS' BREAST PLATE SETS

S. C. white enameled breast plate operator's sets complete	$5.00
S. C. No. 23 plugs for same	.35
New mouthpieces for same	.50
S. C. No. 20 operators' receivers and head band	2.00
Kellogg S. and S. Co. No. 1076 operators' breast plate sets complete	5.00
S. C. and Kellogg jacks for above sets	.35

BUCKEYE TELEPHONE and SUPPLY CO.

COLUMBUS, OHIO

Northern White Cedar Poles

Northern White Cedar Poles in lines of Chicago Telephone Co., on Wentworth Ave., south from 61st St. Set in 1899.

Far in the Lead!

THERE are more Northern White Cedar Poles in use in telephone lines than any other kind.

What greater proof could there be that Northern White Cedar poles are proving most efficient, satisfactory and economical?

The same happy combination of advantages that made Northern White Cedar the "original" pole timber is still the standard of comparison for all telephone poles.

Among those advantages are light weight, strength, good appearance, proper taper, and long life. At any time during the life of Northern White Cedar Poles, you can cut gains and install new cross arms without exposing poles to decay.

Northern White Cedar Association

Minneapolis - Minnesota

Time-Tested – Why Experiment?

Kodel Makes Electrolysis Drainage Valve

The problem of successfully draining stray electrical current causing electrolysis or chemical decomposition has apparently been solved through the discovery of the rectifying properties of a new metallic element discovered by Prof. S. J. M. Allen, Post Graduate School, College of Engineering, University of Cincinnati. This new element, known as Kuprox, is already well known in the radio industry, where it has been used with great success for the elimination of batteries, tubes, etc., and in the charging of batteries where batteries are used; and is fast gaining recognition in telephone and telegraph applications, and in railway signal service.

The Kuprox electrolysis drainage valve is already rendering efficient service in many sections of the country, where engineers have constantly faced the problem of electrolysis decomposition, and the saving that is to be expected from the elimination of the decomposition of underground structures is admittedly almost beyond comprehension, over the period of years that such a saving is to be made by the installation of those valves. Kuprox is manufactured solely by the Kodel Electric and Manufacturing Company, Cincinnati, Ohio, who own all patent applications and rights for the manufacturing of this new rectifying metal for the world. Originally this manufacturing company was known as the Kodel Radio Corporation, adapting Kuprox exclusively for radio operation, but the tremendous market for the product in the industrial field brought about the change in name to be more applicable to the broad field in which Kuprox is now being used.

Additional information about Kuprox and its application to the electrical and rectifying field may be obtained by communicating with A. J. Kohn, industrial sales manager, The Kodel Electric and Manufacturing Company, Cincinnati, Ohio.

Phone Service Between Madrid and Germany

The International Telephone and Telegraph Corporation announces that long distance service was successfully inaugurated August 11th between Madrid and Germany over the lines of the Compania Telefonica Nacional de Espana, an associated company. The line was opened by the Director of Communications of Spain who conversed with the Secretary of Posts and Telephones in Berlin. Afterward the Vice-President of the Spanish Government spoke with the Minister of Interior and the Spanish Ambassador in Germany.

Kentucky Telephone Company Adds Additional Lines

The Owsley Telephone Company of Owsley, Kentucky, has added more than 100 miles of telephone lines during the present year. Some of this is for extensions and the balance replacement.

RECONSTRUCTED EQUIPMENT

Automatic Elec. Co. No. 60707 late type Wood Hotel sets with Ind. coil ckt., complete with Trans., Rec. and Dials, @ $4.75
Auto. Elec. Co. No. 60825 latest type Steel Hotel sets with Ind. Coil, Booster ckt., complete with dials (enclosed gong type) @..... 7.25
Auto. Elec. late type Desk Sets, complete with dials and Ind. Coil ckt., black finish wood signal sets with either straight line or harmonic ringers, @ 6.50
Auto. Elec. Co. latest type Desk Sets, complete with dials, Trans., Rec. and cords @ $5.00; with enclosed gong type steel signal sets @..... 7.50
Automatic Elec. Permanent magnet type Receivers complete with cord @.... 1.10
Auto. Elec. Direct Current Receivers, complete with cords @..... .70
Kellogg No. 97 or No. 118 C. B. Desk Sets, complete with No. 75 or No. 259 Steel signal sets @..... 7.25
Western Elec. No. 20 Desk Set, complete with 3-bar 1000 or 1600 ohm exposed post signal set @..... 9.50
Kellogg No. 2696 type 4-bar 1000 or 1600 ohm Bdg. compacts @ 8.50
Reliable Elec. 5 Amp. Wood Copper tip fuses. Distance between shoulders 4¾ inches. Same as Cook A7, per hundred 3.50
Reliable Elec. No. 56 7-amp. fuses, distance between shoulders 4 inches, per hundred @ 3.50
Stromberg No. 986 or 681 type C. B. Desk Sets, complete with No. 1132 Straight line or 16-33-50 or 66 cycle steel signal sets @ 6.75
4 foot 3 Cond. New Grabaphone or Desk Set Cords @ ..... .15

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Throw Away All Your Old Rat and Mouse Traps
CY-ANO-TOX
Kills All Rats and Mice Instantly While Eating

CY-ANO-TOX is mixed ready for use and KILLS INSTANTLY while the animal is eating at the bait. Death comes to the rodent in fifteen to thirty seconds. He dies right where you place the bait and you do not have to wonder and worry about having any disagreeable odors from decomposing carcasses. You find the dead animal's body at the bait. It is a simple matter of disposing of the dead body right away.

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FOR SALE

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Stromberg Carlson 4 bar 1600 short type wall telephones, $8.50.
Leich 7A ringing machines, operates from 110 volt A. C. current, $40.00.

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Highest prices paid for discarded or obsolete telephone and switchboard apparatus; platinum contact relays, ring keys, etc. Have specialized in this field for many years.
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TRAVELERS select the Great Northern for its wonderful location in Chicago's "loop". They return because the large comfortable rooms, homelike environment, attentive service, excellent food and moderate charges make it an ideal hotel.

400 Newly Furnished Rooms
$2.50 a day and up

Sample Rooms
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